# ARMY ORDNANCE

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**Pledged to Industrial Preparedness as Our Strongest Guaranty of Peace**

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# THE ARMY ORDNANCE ASSOCIATION

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THE Army Ordnance Association is a national organization of American citizens pledged to industrial preparedness for war as our nation's strongest guaranty of peace.

The Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency, time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

The Army Ordnance Association believes that the solution of this problem, based on experience, lies in an active organization at all times coöperating with the Government. The principal objective of the Association is an active membership of American citizens, on whom the duty of design and production of munitions will fall in war, who will have an accurate and authentic knowledge of the complex requirements of ordnance. "Peace insurance" in this form is the foremost aim of the Army Ordnance Association.

The Association is devoted solely to the national defense; it has no commercial interests, no political alliances, and no religious affiliations. It is not operated for profit: its income is expended in furthering its aims. Its officers and directors serve without remuneration. Membership, to which American male citizens are eligible, is four dollars a year. (Application on request.)

ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

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To assist in effecting industrial preparedness for war as being one of the nation's strongest guaranties of peace;

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To promote mutual understanding and to effect coöperation with American scientists, inventors, engineers and manufacturers in civil life and the Regular and Reserve officers of the Ordnance Department;

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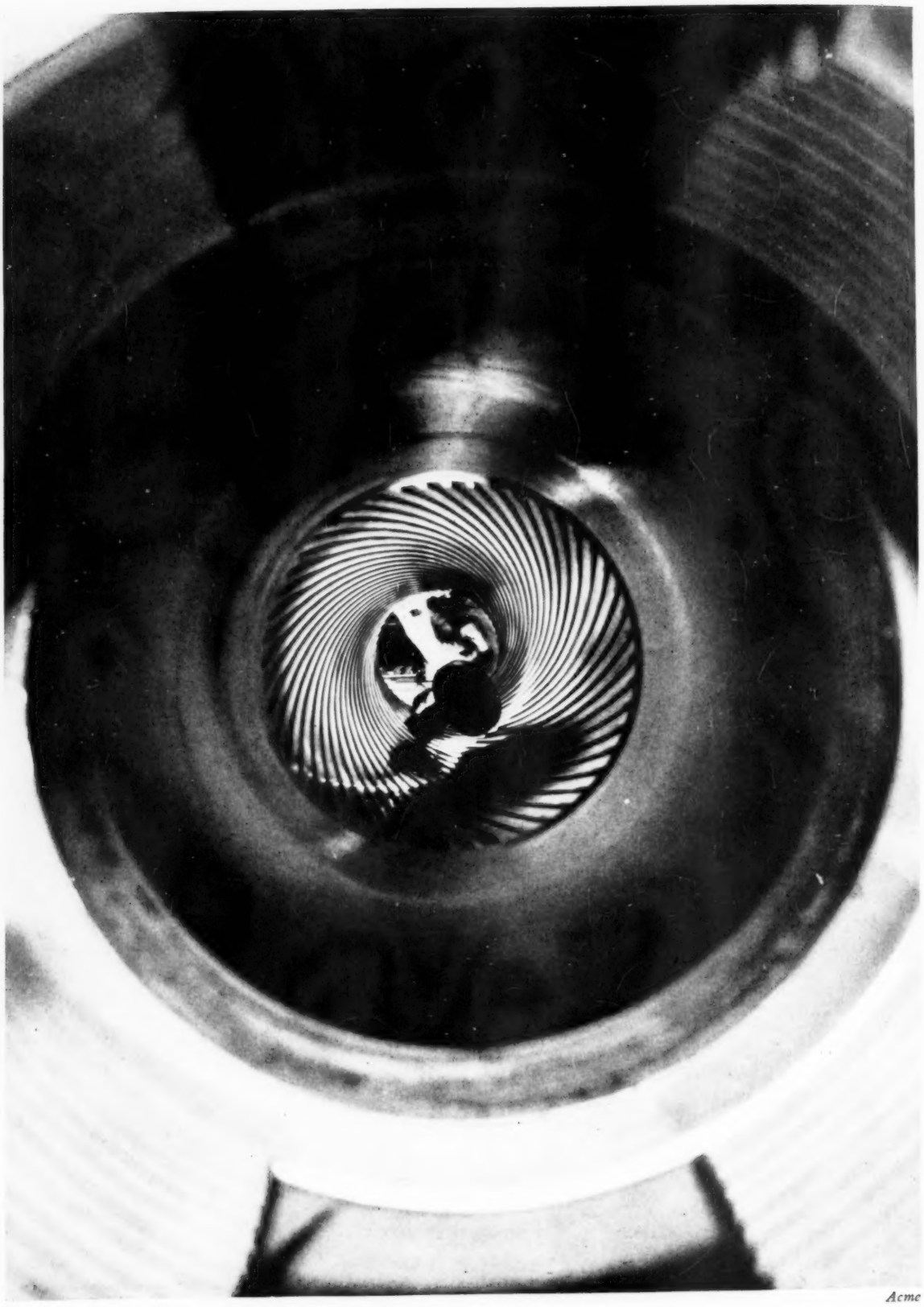

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Inspection

# ARMY ORDNANCE

Volume XXI NOVEMBER-DECEMBER, 1940 No. 123

# Coast Defense

## A Plea for Protection of the Atlantic Seaboard

By Maj. Gen. Johnson Hagood*

IF an enemy ever decides to come over to this country, he will have to come over in boats. And he must make his landings either in the United States, in Canada, or in Mexico. The most natural and convenient place, of course, would be in the United States, and it is with that problem that this article has to deal.

In order to make a landing in force, an enemy will have to have the use of a harbor, fully equipped with docks, wharfs, and unloading facilities. He must have railroads and highways, giving him access to the interior. He cannot just dump his tanks, his heavy artillery, his motor transportation, and other such cargo upon beaches. Small parties, if unopposed, might make such landings and might go around and capture a harbor from the rear; that is something we must guard against. But the main thing, and that is the purpose of seacoast fortifications, is to keep an enemy from coming in by the front.

The principal defense of the United States must be by the Navy. We are an insular nation, self-contained in every respect. We, on the other hand, can send our troops and supplies to any part of the country by motor truck and rail. Our fleet does not have to be dissipated for the protection of trade routes or colonies; nor does it have to provide convoys. It can, therefore, and should, be entirely free to plow the high seas and to engage the enemy in full force wherever he may be found.

In order to do this, however, the Navy must be relieved of all responsibility for local defense. It must not even be required to defend its own navy yards. It is the duty of the Army to provide this protection for our Navy and for our harbors of commercial and strategic importance. Any failure to do so is a betrayal of trust. It may come from ignorance or neglect in time of peace. But if war comes and finds it so, it makes no difference to the enemy why the guns don't shoot, just so they do not.

Our eastern coast may be roughly divided into three defensive areas: (1) The New England area with its three principal harbors at Portland, Me.; Portsmouth, N. H.; and Boston, Mass.; (2) the Middle Atlantic area, with its five great inland waters—Narragansett Bay, Long Island Sound, New York Bay, Delaware Bay, and Chesapeake Bay; (3) the Southern area, containing a number of small harbors and naval installations at Charleston, S. C., and at Pensacola, Fla.

All our naval bases upon the Atlantic coast, except the one at Guantánamo, are contained within these great natural strong points which have been occupied and fortified in one way or another since before the Revolution. Many of them have seen fighting. At about the time of the Civil War, the forts defending these bases were considered to constitute one of the strongest systems of seacoast defense in the world, well able to cope with anything that could be brought against them. And the same again in 1915. But not now.

Today they are lacking in guns, mines, submarines, and aircraft—in organization and in men. Twenty-five years ago, every important harbor could be closed to a hostile fleet upon twenty-four hours' notice. Today it is a question whether they could be closed at the end of six months. Every other department of the Army and the Navy has gone forward. The coast defenses have gone back.

THE present system of seacoast fortifications was laid out originally in 1886 by a board appointed by President Cleveland and headed by William C. Endicott, then Secretary of War. Their plans were revised and brought up to date by another board headed by William H. Taft, a later Secretary of War. The Endicott Board actually had to start from scratch. We had no Navy to speak of, and we had no forts except those armed with the old muzzle-loading guns—many of cast iron—that had been left over from the Civil War. It planned for foundries and machine shops, for the construction of high-power, breech-loading steel rifles, and for the making of armor plate. Under the impetus of this board, we developed smokeless powder, high-explosive shells, and telescopic range finders. We became pioneers in the military use of electricity, of telephones, and of gas engines. We fortified twenty-seven of our principal harbors "because of their commercial and strategic importance." And in these harbors we constructed fifty-seven separate forts.

These forts had reënforced-concrete emplacements protected on the outside by thirty feet of earth. There were guns from five inches in caliber up to twelve, capable of shooting with great accuracy up to seven miles. There were range finders that could locate a target to within five yards of its true position, searchlights for locating the enemy at night, mines that were controlled from the shore, magazines for the protection of ammunition, and parapets behind which no man at the guns could be hit by a shell from a ship of that day.

When the World War came, the seacoast forts were stripped of their men and guns which were sent to France. It was expected that at the close of the war new methods would be developed and an entirely new system of seacoast defense devised.

Instead of that we took to the woods. That is, instead of strengthening our forts in position, as all the rest of the world was doing, we drew back into the woods or behind the hills

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with an impractical system of railroad and motorized artillery. This was done with a twofold purpose. First, to hide from airplanes, and, secondly, to effect an imaginary saving by shifting the guns about from one part of the country to another as the plans of the enemy were developed. Thus, most of the fortifications were either abandoned or placed in the hands of caretakers. The barracks vacated by the demobilized artillery were turned over to the infantry.

We can take as an example the defenses of New York. Formerly there was an outer line of forts across the eastern entrance to Long Island Sound, from the vicinity of Montauk Point to the Connecticut shore. One fort in this line is still partially garrisoned. The others are either in the hands of caretakers or have been abandoned. Then there was an inner line at the western end of the Sound running from Fort Totten to Fort Schuyler and to David's Island. All the forts in this line have now been abandoned so far as any seacoast defense is concerned. There is an antiaircraft regiment at Fort Totten available for use on the defense or with the mobile army. To the south, there was an outer line from Sandy Hook to the vicinity of Coney Island. The two forts on that line are now partially garrisoned. And there was an inner line from Staten Island to Long Island in the vicinity of Brooklyn. The two forts there are now occupied by infantry.

THE general situation throughout the Atlantic coast is as follows: We have a few modern guns, particularly some 14- and 16-inch guns we obtained from the Navy, that can shoot twenty-five miles; and we have a number of older guns that still could give a good account of themselves. But the Army has developed no new range-finding methods by which we can utilize the full value of the range. Even on the clearest nights we cannot locate a hostile vessel at a distance of more than seven miles, and in thick weather, even in the daytime, this is reduced to two or three. Smoke or artificial fog would produce the same effect.

The old guns are mounted on disappearing carriages, or otherwise, so that they are partially protected from the direct fire of ships—but not from the fire of airplanes. The new guns have no protection at all. They are located in some cases back in the woods, or behind sand dunes, but the two 16-inch guns that constitute the main defense of New York are set up right out in the open at Rockaway Beach. They must depend for protection upon camouflage.

In addition to the guns, our harbors are provided with a system of outer mines and antisubmarine nets operated by the Navy and with an inner system of mines operated by the Army. The Army mines are connected with the shore by cables and fired by electricity. But most of the cable was purchased and placed in storage nearly thirty years ago. It is now in very bad shape. Special seagoing tugs were constructed as mine planters, and mine companies were designated to lay and operate the mines. There are no mine companies any more, and the planters are used as ferryboats. The soldiers live in wooden or brick barracks near the batteries, just the same as they would at any Army post in the Middle West. There is nothing about one of our harbor defenses that faintly resembles what they call a fort in Europe. Some of them look like the back areas we occupied on the Western Front.

There is an old saying that one man in a trench is as good as ten men in the open. By the same token we can say that one man in a fort is worth a hundred men in a boat. The Germans quietly, secretly, and efficiently organized a force for the invasion of Norway. It consisted of army, navy, and air force; of mines, submarines, and what is known as the "fifth column," or propaganda and treachery. They entered the harbor of Oslo and with a small force of men captured a city of 223,000 souls. The seacoast forts fired and sank two of the German warships, and then their firing ceased.

It made no difference to the remainder of the attacking fleet whether the shore guns ran out of ammunition, whether they stopped firing by order, or whether they did not exist. The salient fact was that the Germans went on in unopposed, tied up at the docks, put their men and supplies ashore, and proceeded to overrun the country. Thus the odds were changed from one hundred to one against the German in the boat, to one hundred to one in favor of the German on the shore.

HOW does this apply to the United States? The British, in 1814, sailed into Chesapeake Bay and up the Potomac River. They landed on the Maryland shore and after a short fight, in which the Americans lost twelve lives, captured the City of Washington, burning the Capitol, "the palace of the President," and the Treasury. In so far as any seacoast fortifications are concerned, the British Navy or any other modern navy could come into Chesapeake Bay just as easily as the warships went into Oslo. The Germans got into Norway, not because the British Navy had been wiped off the seas, but because the British Navy was otherwise occupied at the moment when the dash was made across the Baltic. Had the Norwegian forts held out for a week, or perhaps even for forty-eight hours, it might have been a different story.

The Confederates at the entrance to Charleston harbor, with Fort Sumter, held out for two years in the face of the longest and most devastating bombardment in naval history, and yielded only when Sherman came down from the rear. Properly constructed fortifications could do the same thing now. But there are no properly constructed forts at Charleston or anywhere else on the Atlantic coast. There is not a properly fortified harbor from the St. Lawrence to the Rio Grande. There is no such thing as concerted action in the seacoast fortifications of the United States.

If New York harbor were attacked, the submarines, the coastal motorboats, the outer mines, and certain of the aircraft would be operated by the Navy. The guns on shore, the inner mines, certain of the aircraft, and the mobile troops would be operated by the Army. Within the Army, the guns and mines would be controlled by one man, the aircraft by another, and the mobile troops by a third. There would be no coördination between these various Army units except through the corps-area commander and his staff, or by some other incidental authority who probably never had any experience or particular knowledge of such matters. In case an enemy bomber should appear, it would be simultaneously attacked by Navy airplanes, from the shore by Army airplanes, and by Army antiaircraft guns. There would be a corresponding confusion in the use of flares, searchlights, etc.

At the conclusion of the World War, General Pershing said: "In each succeeding war there is a tendency to proclaim as something new the principles under which it is conducted. Not only those who have never studied or experienced the realities of war, but professional soldiers frequently fall into the error. But the principles of war as I learned them at West Point remain unchanged."

An organization was worked out many years ago by one of the ablest Coast Artillery officers America has ever produced—Maj. Gen. Arthur Murray. Under this plan, the fortified area, together with all the included implements of defense, would be under the command of one man, thoroughly competent to perform that duty. And neither the death nor disability of the permanent commander, nor the casual presence of someone else senior to him in rank, would be permitted to disturb this principle.

THE harbor defenses of the United States should be organized as follows:

First, a competent officer should be assigned to the command of the fortified area. It makes no difference whether he be an officer of the Army or an officer of the Navy; nor does it matter what may be the color of his stripes. He should be assigned by the President, and should have *ex-officio* rank, both in time of peace and in time of war, sufficient to insure his not having to give up the command to someone else who might happen along. Some such arrangement is contemplated in the Articles of War. Moreover, the line of succession should be so fixed that in case of siege, or otherwise, it would be impossible for the command to devolve upon some person for whom it was not intended, or who was not qualified by training and experience to exercise it.

Secondly, within the fortified area of the land and the sea, the commander of the fortress should have under his control the fixed permanent fortifications, the inner mines, and the aircraft, submarines, and coastal motorboats (small torpedo boats) assigned to the local defense; also the mobile troops known as the artillery supports, whose purpose is to protect the rear of the forts from enemy raiding parties. The submarines and motorboats, of course, would be operated by Navy personnel. The aircraft and all the other various Army activities would be operated by officers and men who were qualified by training and experience for that duty. And the staff of the fortress commander would be similarly composed.

Thirdly, between the fortified areas the coast would be protected by mobile troops, organized to the best advantage for the problem at hand; that is, to repel invaders who may attempt to force the shallow waters, or to operate in open warfare upon the land.

Fourthly, in Washington, there should not be a Chief of Coast Artillery, who, like the Chief of Cavalry, the Chief of Infantry, and others, is little more than the representative of a group of individuals that use the same weapons. There should be an Inspector General of Coast Defense, or some such officer, who should be the adviser upon all matters pertaining to the fortified areas, including weapons, personnel, and supplies that go within these areas, and excluding all that go without.

The Coast Artillery and the Field Artillery should be combined, and the various units, officers, and men assigned to duty with the coast defenses or with the mobile army as occasion might require. That is in effect the way it operated during the World War. Out of the present authorized strength of the Regular Army, thirty thousand officers and men should be assigned to the coast defenses for the service of the big guns, the antiaircraft artillery, and the mines of the United States proper, exclusive of the Panama Canal and Hawaii. At the outbreak of war, these should be supplemented by the instantaneous mobilization of National Guard organizations, now already trained for that purpose. These, under the plan of General Murray, were known as artillery reserves. In addition, there still should be artillery supports; that is infantry, artillery, etc., whose duty it would be to resist landing parties in rear.

Airplanes, with air troops, should be permanently assigned to the coast defenses at the rate of one plane for each two major-caliber guns, and in conjunction with the artillery should develop a practical system of observation and range finding for the big guns in the forts, such as they already have done for the Navy and for the smaller guns of the Army in the field. Airplane bombing of enemy vessels in conjunction with fire from the shore also should be developed.

TWO hundred million dollars should be made immediately available for the complete rehabilitation of our whole system of coast defense—a very small sum as compared to the forty billions we spent during the last war in our effort to stop the enemy on the other side.

This would permit us to undertake the following:

(1) Tear out all the antiquated batteries and replace them with guns protected by steel turrets capable of resisting high-explosive shells fired from the sea or dropped from the air;

(2) In addition to a reconstructed Fort Story at the southern entrance to Chesapeake Bay, construct another fort at Cape Charles on the northern side and an additional one upon the submerged shoal known as the Middle Ground;

(3) Construct additional forts in the Houston-Beaumont area of Texas with special reference to the protection of the oil fields;

(4) Replace our 1898 models of range-finder towers (in many cases constructed of wood) with bombproof structures equipped with automatic mechanical computers such as we now have for our antiaircraft guns;

(5) Provide bombproof and gasproof shelter for the war garrisons with all necessary provision for their maintenance and supply;

(6) Provide an adequate supply of seacoast ammunition commensurate with the life of the guns;

(7) Provide a sufficient number of antiaircraft guns for use within the fortified areas;

(8) Replace all mine cable and provide more modern means for the operation of the mine fields, especially with regard to planting and repair at night in the face of the enemy;

(9) Modernize our mine planters and return them to their normal work;

(10) Provide the necessary equipment for converting lighthouse tenders and harbor boats into emergency mine planters;

(11) Provide a sufficient number of harbor boats, barges, and tugs to meet the ordinary conditions of peace (the same for motor transportation);

(12) Provide harbor-defense submarines, capable of operating in shallow water, and the new coastal motorboats (small torpedo boats) recently adopted by the Navy;

(13) Provide aircraft suitable for harbor-defense work in connection with the guns on shore.

With such a system of coast defense at home; with a high-seas fleet too strong to be defeated in our own waters and too weak to fight abroad; and with a relatively small mobile army capable of immediate expansion, we need not worry ourselves about invasion from Europe.

# The New Ordnance Battalion

## Maintenance and Supply in the Streamlined Division

By Capt. Joseph M. Colby*

RECENT publicity has stressed the point that the new Streamlined Division has thrown off encumbering supply-and-maintenance units and has become a fast-moving organization composed almost entirely of combat personnel. However, in view of increased mechanization and the universal use of automatic weapons, with resulting increase in fire power and mobility, it is obvious that military success is now more dependent than ever on efficient maintenance and proper flow of supply. The problems of supply and maintenance themselves have grown in magnitude and difficulty of execution; hence, the questions arise: Where have the maintenance-and-supply units been placed? How are the maintenance-and-supply functions now performed? The ensuing article will explain how this was done with ordnance maintenance and general supply in the Fourth Corps during the April-May field exercises of the Third Army.

Generally, the questions may be answered by stating that the ordnance-maintenance units were moved from the divisions and the Field Artillery brigade back into corps troops to form a battalion under centralized control. Left organic in each division is a small Ordnance section, composed of one officer and sixteen men, which operates under the direct control of the division Ordnance officer. This not only has aided in further streamlining the combat units, but also has resulted in improved Ordnance service for the following reasons:

(1) Greater economy of force—the bulk of the maintenance organization can be thrown where maintenance is most required; (2) Greater economy and availability of spare parts—the load of spare parts of any company becomes a potential reserve for any other company; (3) Greater economy of skilled personnel—each company usually possesses one or two mechanics unusually adept in some particular line of maintenance, and these men can be used to solve the more difficult problems and their skill transferred by instruction to the lesser adept; (4) Greater economy in the use of tools, facilities, and equipment—with the battalion organization, only one each of certain tools is sufficient to serve the entire battalion.

This reorganization has increased the potential capacity of Ordnance general supply-and-maintenance units to serve the mobile, high-powered combat units without a corresponding increase in Ordnance personnel and equipment.

THIS was the first Ordnance battalion ever assembled and operated in our Army; hence the start was from scratch with nothing to serve as a guide but a number of untried theories. Companies were composed largely of recruits with no maintenance training whatsoever. Company commanders were Reserve officers, only one of whom had had extended active duty. Many noncommissioned officers had but recently received their warrants; hence were without adequate training to exercise command responsibilities or to supervise maintenance. The companies arrived at the Fort Benning concentration area with little or no equipment. In other words, the original organization approached closely what might be expected of an organization mobilized on M-day. The Ordnance Battalion, Fourth Corps, had its "growing pains," but it emerged from the field exercises well developed, well equipped, operating smoothly, and effectively executing its mission.

The Ordnance officer, Fourth Corps, was also the commander of the corps Ordnance Battalion. The battalion operated as an independent unit without reference to the commander of special troops. All administrative reports were forwarded directly to corps headquarters. Likewise, all corps instructions and orders were transmitted direct to the Ordnance Battalion. The following advantages gained from this procedure are sufficient to recommend its continuance: (1) The Ordnance officer who is responsible for maintenance and supply of ordnance within the corps is provided the necessary means under his direct control for carrying out his responsibilities. (2) The rapid transmittal of information and instructions to operating personnel as soon as plans are formulated and decided upon in corps headquarters is facilitated. (3) Greater freedom of action and flexibility in Ordnance operations are permitted.

THE first problem to meet solution concerned the location of the office of the corps Ordnance officer. The question of the location of the Ordnance officer in the forward or rear echelons of unit headquarters had been debated for years. To many, the logical place for the office of the corps Ordnance officer was at the bivouac of his battalion. This theory was based on normal peace-time post routine under which most special staff officers locate at the point of operations. Consequently, at the opening of the first exercise, the corps Ordnance officer was directed to open office at the battalion bivouac site. But before twelve hours had elapsed, the failure of communication and the need of the Ordnance officer in evolving plans resulted in his being rushed to the forward echelon of corps headquarters from which place his office never moved.

Since tactical plans must consider ammunition supply and since effective execution of the ammunition plan is based largely on information furnished by personnel at corps headquarters, it follows that the ammunition supply officer also moved to corps headquarters. This left the battalion executive in continuous immediate command of the battalion.

The Ordnance Battalion, Fourth Corps, was organized as shown in Table of Organization 9-75, less one ammunition company. The medium-maintenance companies were the 1st, 15th, and 34th. The 51st Ordnance Company (Ammunition), was alone in simulating the actions of two companies.

Table of Organization 100-1 provides an Ordnance section, and Table of Organization 9-75 provides a headquarters and headquarters detachment. The personnel shown under the Ordnance section formed the staff of the office of the corps

*Automotive and Research Division, Aberdeen Proving Ground, Md. Formerly Commander, Ordnance Battalion, Fourth Army Corps. Captain, Ordnance Department, U. S. Army.

THE MODERN ORDNANCE BLACKSMITH USES A MOBILE MACHINE SHOP

Ordnance officer, were carried on corps headquarters rolls, and after the opening day of the field exercises never again were intimately associated with the administration of the battalion. This left in battalion headquarters one officer and nine enlisted men as shown in Tables of Organization 9-75 under the column "Headquarters Detachment." The experiences of the field exercises demonstrated that the following personnel in battalion headquarters are essential for efficient operation:

1. Executive.—The battalion commander, as corps Ordnance officer, is so busy with staff work, ammunition allocations, preparing plans and reports, supervising ordnance activities, and rendering support at weak links or choke points that it is impossible for him to exercise continuous immediate command. He must have a second-in-command charged with discipline, training, supply, supervision and coördination of maintenance operation, and the execution of administrative or tactical moves.

2. Adjutant.—Military administrative matters such as consolidated strength returns, consolidated truck returns, daily telegrams, and frequent other reports required by higher headquarters need the attention of a single officer. He also insures the receipt of instructions from higher headquarters, ascertains the location of ration dumps, water dumps, and the time of delivery. He maintains the operations map essential to contacting the units in the field. He insures the timely delivery of instructions and orders to proper subordinate personnel. In addition, the adjutant acts as publicity officer, census enumerator, recruiting officer, and other incidental jobs which constantly come up.

3. Supply and Shop Officer.—An officer charged principally with supply is essential to the proper functioning of the Ordnance Battalion. Many of the supply agencies will be required to deal with only one representative of the battalion. A mission that normally would require the attention of three company commanders can be executed by this one officer. He is also essential to insure the timely order and receipt of spare parts, to maintain a proper level of stockages, to supervise the shop bookkeeping necessary for the proper record of shop activities and the availability of spare parts. As shop officer, he is charged with the proper coördination of maintenance activities among the several companies. In addition, this officer functions as purchasing officer, battalion summary court, battalion claims and damage officer, motor vehicle accident investigating officer, and other incidental jobs as they arise.

4. The enlisted personnel at battalion headquarters fall naturally into two sections: A military section, operating directly under the adjutant, and a supply and shop section operating directly under the supply and shop officer. A recommended organization of the above sections follows: *Military Section.*—Sergeant major, clerk (military records), messenger (liaison with corps), messenger, and chauffeur; *Supply and Shop Section.*—Shop foreman, shop inspector (reports direct to battalion commander), supply sergeant, clerk (shop's records), and two messengers.

EXISTING tables of organization and tables of basic allowances provide no equipment for the establishment of battalion headquarters. This equipment now must be imposed as excess property on one of the companies of the battalion. This may be a suitable expedient in peace-time maneuvers when no permanent battalion headquarters exist, but provision should be made definitely for battalion property in the war organization. A 1½-ton truck with trailer for the transport of battalion headquarters equipment and for the performance of battalion headquarters' missions also should be provided.

Tables of organization provide for one 5-passenger sedan and four motorcycles. These were not available during the past field exercises and their need was urgently felt.

The ammunition-supply problem, which is a big story in itself, will be dismissed here by stating that the ammunition company was assigned to the Ordnance Battalion for military administration. In performing its mission of ammunition supply, it operated directly under the control of the ammunition supply officer, now in corps headquarters.

10:45 A.M.—155-MM. GUN REPORTED TO BE HOPELESSLY FLATTENED

There were two principal theories on the battalion organization of the maintenance companies. These might be termed "functional organization" versus "tactical organization." In the functional organization, the maintenance sections of the several companies were to be brought together into a corps Ordnance shop with like sections grouped. Thus the artillery sections of the three companies, in the functional type organization, were centralized in the shop as a shop artillery division. This applied to spare parts and messing facilities, as well as the maintenance sections. This theory was advanced on the desirability, well demonstrated in peace-time post Ordnance service, of grouping like skills and machines and placing on this group the responsibility of certain specialized maintenance and inspection functions.

Again, normal peace-time routine failed to serve as a pattern for field service. First, there was confusion among the men who operated under two commanders—their respective company commanders and the officers in charge of their respective shop divisions. Secondly, there was some hesitancy among officers in charge of the shop division to exercise proper supervision and control over men from other companies. Thirdly, there was the objectional dual responsibility for the care and preservation of tools and equipment. Fourthly, there was further confusion in moving from bivouac into march column and back into bivouac again. In other words, there was a great shuffle in going from shop formation to company formation for the march and back again.

To many, the obvious solution was to specialize the companies. Thus we would have an automotive company, an artillery company, a service company, etc. But further analysis showed that this organization would have many of the above-mentioned objections in other operations, such as when a balanced-maintenance unit would be required in support of a tactical unit on a distant mission. Either of the above set-ups is based on the idea of a single shop; hence each is too inflexible to meet the requirements of rapid tactical movement, as will be demonstrated later. Further, our contacts with subordinate units of the corps were complicated because the above organizations are based on specialization of type of equipment and not on the principle of supporting a tactical unit of all arms with a balanced-maintenance force.

Not much is said above in favor of the functional type of organization for the simple reason there is not much that is good to say about it; hence we were only too happy to enter the second phase of our problem because its solution was becoming obvious to all of us.

AT the conclusion of the corps phase of the field exercises and before the move to Louisiana, the "tactical organization" was adopted. That is, each company maintained its identity both for administration and operation as a completely integrated unit. The men now had only one commander—the officer they knew best. The company commanders could exercise full control over the men and equipment for which they were responsible. The battalion commander could definitely place responsibility and, in addition to this, also could eliminate the confusion of the "shuffle," operate with greater flexibility, and provide more efficient Ordnance service.

The flexibility of the new organization—that is, its ability to conform to rapidly changing tactical and strategical requirements—began to show itself at once. The Fourth Corps marched from Fort Benning to Camp Beauregard in five columns over two routes. The Ordnance attachments were as follows: 6th Cavalry, detachment, 15th Ordnance Company; Fifth Division, 15th Ordnance Company, less detachment; Sixth Division, 1st Ordnance Company; First Division, detachment, 34th Ordnance Company; Fourth Corps (less detachments), Ordnance Battalion, Fourth Corps, less detachments. Since each Ordnance company is a well-balanced, self-sustaining unit, and since normal attachments had been worked out for each unit of the corps, the battalion order for the march consisted basically of two words: "Attachments, normal."

Thus each march unit was provided an attached balanced-maintenance unit while it was distant from the corps. The detachment, 15th Ordnance Company, not only supported the 6th Cavalry during the screening and contact phases, but also formed the advance party to reconnoiter and plan the new bivouac area of the Ordnance Battalion, and to guide the Ordnance detachments to the new bivouac as they arrived in the corps zone of action. All Ordnance detachments reverted to battalion control as the subordinate units of the corps entered into the new corps assembly area.

As the battalion assembled, each company was assigned a separate area for its bivouac and shop and henceforth operated as an entity according to instructions emanating from battalion headquarters.

Maintenance responsibilities of the companies were based on territorial assignment. Before each exercise, the tactical plan was explained to assembled officers, and the zones as-

signed to companies in which they would be responsible for the daily contact and maintenance of the tactical units operating therein. Daily, or more often if necessary, these assignments were adjusted to meet the rapid and unpredictable varying tactical changes. Care was taken to assign the zone containing corps artillery with its specialized equipment to the 34th Ordnance Company which had the training and equipment necessary to maintain this matériel. Likewise, the zone assigned to the 15th Ordnance Company included, when possible, the scout cars of the 6th Cavalry.

An operations map was maintained by the adjutant. The basic information for the map was obtained from Fourth Corps headquarters, the daily reports of visiting maintenance crews, the reports of personnel from tactical units bringing in equipment for repair, and the reports of personnel operating ammunition trains. Much of the time our operations map was more revealing of the existing situation than that in corps headquarters, the reason being that our map was based on actual contact with subordinate units of the corps rather than on communications which are so easily lost or distorted.

2:00 P.M.—GUN REPAIRED AND READY TO MOVE OUT WITH ITS UNIT

THE great flexibility of the "tactical organization" of the battalion shop was well demonstrated in the Louisiana phase of the field exercises. Thus, in the opening phase, the battalion was concentrated. As the troops advanced, the 1st Ordnance Company was advanced to a new bivouac and shop site to render close support. The other two companies remained in the old bivouac to clean up all maintenance at that site.

In the meantime, one division and the scout car squadron of the 6th Cavalry was ordered eighty miles to the right flank for an attack. The 15th Ordnance Company was ordered to that flank in close support. Hence, at this time, each company of the battalion was at a separate site, each performing a much-needed mission. The 34th Ordnance Company at the old bivouac not only cleaned up remaining maintenance but also took care of maintenance coming in from those units not yet informed of the advanced Ordnance shop site. The next day, the 34th Ordnance Company moved forward to the advanced site. As the flank attack closed in on its objective, the 15th Ordnance Company rejoined, and the battalion was again reassembled.

The only orders required during the operation were to instruct the particular company concerned to move to a selected site for the purpose of maintaining certain units within a given zone of operation. The above operations conclusively demonstrated to all concerned that a corps Ordnance battalion can carry out its mission of maintenance more effectively and with less confusion if organized along tactical lines; that is, containing a group of well-balanced, self-sustaining units, each capable of maintaining the equipment of a force of all arms.

The maintenance companies had an authorized peace strength of one officer and forty-nine enlisted men. They were authorized the necessary transportation of twenty-three trucks, one passenger car, and one motorcycle. This left less than two men per vehicle, did not provide for necessary relief drivers and, when details were withdrawn for battalion headquarters, kitchen, and company headquarters, seriously limited effectives for maintenance. As noted above, each company had only one officer.

These officers not only have complicated company property accounts but have more complicated accounts of fast-moving general supplies, for all of which they hold stock records. The attention these officers must pay to their company administration and property accounts seriously interferes with their duties of maintenance. A difficult situation relative to property would arise should one of these be sent from his company for any length of time. At least one more officer and nineteen enlisted men per company are desirable. A new table of organization, Table of Organization 9-7, corrects these deficiencies.

In general, the companies are provided with excellent necessary tools and equipment. However, a definite need was experienced for tools which are not in the medium-maintenance companies. These shortages include: (1) One lathe of the gap-frame type, now in the heavy-maintenance company; (2) one medium-size milling machine; (3) a wrecker truck of the type now in the heavy-maintenance company, to be used for maintenance of diesel tractors, 155-mm. guns, 155-mm. howitzers; (4) a 40-ton hydraulic press for pulling off and pressing on gears and bushings as well as for use in the blacksmith shop for straightening such items as 155-mm. gun drawbars and tie rods on guns and scout cars; (5) a blacksmith's forge for heating operations where the use of torches is unsuitable and inadequate.

The above items are or should be included in the heavy-maintenance-company equipment. Because these items are essential to efficient maintenance in the corps, it is recommended that one heavy-maintenance company be included in the corps Ordnance battalion. This company should be considered as a base shop with the lighter companies being available for detached or contact missions. A heavy-maintenance company forms an organic part of Ordnance army troops. The equipment of this company includes the additional items which are now lacking in the medium-maintenance company. The mission of the heavy-maintenance company in the field army is to assist the medium-maintenance companies and to provide Ordnance service beyond the capacity of the medium-maintenance company. A wrecking truck, 70-ton hydraulic press, and folding blacksmith's forge are being

added to the organic equipment of the medium-maintenance company.

Least interesting, most annoying, and yet fundamental in any maintenance-and-supply organization is the problem of property accountability. This is particularly so when peacetime property regulations apply. The problem is complicated because the companies have not only the usual organizational equipment but also fast-moving accounts of general supplies and responsibility for equipment of other units undergoing repair. Because the system for property accounting employed by the Ordnance Battalion, Fourth Corps, is simple, provides for property accountability and responsibility, cuts red tape in the link between the using services and the supply bin, and provides the necessary basic data for stock record cards and battalion maintenance records, it is thought advisable to include here paragraphs 3, 4, and 5 of the Ordnance Plan, Fourth Corps (Circular No. 5, Headquarters, Fourth Corps, Fort Benning, Ga., dated March 22, 1940). Slight changes found necessary as the result of the field exercises are included in the following paragraphs:

"3. *Ordnance General Supply.—a.* During the period of the maneuver, general supplies expended or replaced by the Infantry division Ordnance sections, or by supply officers of corps troops, will be replenished by drawing on the supplies of the Ordnance companies which comprise the corps shops, or when an Ordnance company is attached to a unit, supplies will be drawn from that company.

"4. *Procedure for Drawing and Expending General Supplies During the Period of the Maneuvers.—a.* An accurate account of general supplies consumed during the period of the corps and army maneuvers will be maintained by the corps Ordnance maintenance organization. The corps plan for accounting for the expenditure of general supplies is as follows: *b.* Expendable Ordnance property actually consumed, damaged, or worn out through fair wear and tear and replaced by the Infantry division Ordnance section, or by maintenance sections of corps troops, will be replenished by drawing on corps shops by means of Ordnance Form 112, 'Bill of Material' (yellow). *c.* The corps shops will draw in a similar manner expendable property actually consumed in shop maintenance work. *d.* Nonexpendable property, which has become unserviceable through fair wear and tear and replaced by the Infantry division Ordnance sections or supply officers of corps troops, may be exchanged at the corps shop supply for serviceable property. The unserviceable items will be accompanied by Ordnance Form No. 116, 'Bill of Material' (green). *e.* The same procedure will be used by the corps shops for drawing nonexpendable property. *f.* 'Bills of material' (green or yellow) received in each Ordnance company supply will be posted to Ordnance Form No. 115, 'parts used' list, copies of which will be forwarded to the Ordnance battalion commander at the conclusion of the corps phase and army phase of the maneuvers. These lists will be catalogued showing parts consumed in each Standard Nomenclature List group for each unit served. 'Bills of material' (yellow) should be retained by the Ordnance companies as subvouchers to their respective expenditure reports, which will be completed as soon as possible after the conclusion of the exercises. *g.* The accumulated unserviceable nonexpendable property will be disposed of through 'I and I,' by the maintenance companies in accordance with existing regulations. *h.* Expendable and nonexpendable property consumed by the Infantry division Ordnance sections and corps troops but not replenished by means of 'bills of material' must be dropped from stock records in accordance with existing regulations. List of spare parts consumed but not replenished will be forwarded to corps Ordnance battalion commander at the conclusion of the corps phase and army phase of the maneuvers. *i.* Property to be surveyed will be handled by organizations in accordance with existing regulations.

"5. *Ordnance Property Undergoing Repair.—a.* All property taken into the corps shop for repair will be taken up on work order request form. Officers, or noncommissioned officers in charge of visiting Ordnance crews, as well as personnel at the shop, will insure that the work order request is completely and properly made out before accepting and signing receipt for equipment for repair. Work order requests will be made out in triplicate. The original will go to the unit served as a receipt. The remaining two copies will be turned over to the corps shop officer. *b.* When approved by the shop officer, the work order request will constitute the proper authority for the designated shop to proceed with the work. For routine maintenance work, the shop officer may delegate the responsibility for approval of the work order request to the officer in charge of the company shop. The work order request will be kept in the company shop during the repair as a record of its property responsibility. The shop doing the repair will list on the rear of the work order request the work done and spare parts used. *c.* When the repair is completed, the item will be inspected by the inspector. When the inspector has signed the work order request the item or items will be returned with least practical delay to the unit or the unit instructed to report to the corps shops for its equipment. The signature of a responsible representative of the unit for the equipment on the work order request completes the transaction. *d.* The work order request will then be turned in to the corps shop officer and filed by Standard Nomenclature List group for each organization served. At the conclusion of corps and army phases of the exercises this file will be forwarded to the corps Ordnance officer."

Depleted company stocks were replenished by requisition on the Ordnance officer, army base. His prompt response to meet the requirements of the Ordnance Battalion contributed greatly to the success of maintenance in the Fourth Corps.

SEVERAL questions constantly arose during the maneuvers which might well be answered here. One of the most important was: "Where is the dividing line in the responsibility for maintenance between the using services and the Ordnance service?" Much was said about the things first-, second-, third-, and fourth-echelon maintenance could do and must do. There is only one practical answer. The Ordnance officer, as technical adviser to the unit commander, is responsible for all maintenance regardless of the nice-sounding phrase, "echelons of maintenance." From an Ordnance point of view, there are only two echelons in maintenance operations. The first is the using service which should do all maintenance within the limitations of time, training, or equipment. All other maintenance falls to the Ordnance service.

Thus, with a recruit organization, Ordnance must do, patiently and willingly, first-, second-, and third-echelon maintenance until sufficient skill is passed on to the recruit organization to permit it to do this work itself. Ordnance responsibility, however, is not transferred; it is now exercised by means of inspections and reports to higher authority. Similarly, if, in action, time does not permit the using service to

AN ORDNANCE COMPANY WRECKER TRUCK REMOVES THE ENGINE FROM A TRACTOR

perform all maintenance of which it is capable, Ordnance must be prepared to render full assistance to keep all equipment in operation.

Numerous requests were made by units of the corps for permanent attachment to these units of Ordnance personnel. The necessity of keeping together the essential elements of maintenance—spare parts, facilities, and trained men—for efficient operation precludes a normal attachment of Ordnance personnel with the several units of the corps. However, such attachments can be, and were, made when maintenance in certain of the units became pressing. Thus, a specialist in antiaircraft equipment was attached to the 62nd Coast Artillery for the duration of the maneuvers, and short-time attachments were provided the 6th Cavalry and 13th Field Artillery Brigade. But as long as the "streamlining" policy continues, the limitation on personnel and equipment demands their centralization for efficient and effective maintenance. It follows that the usual method of operation is by contact on liaison details.

A FEW of the interesting maintenance operations carried out during maneuvers are as follows: The replacement of transmission shafts on two 10-ton tractors was accomplished. This operation required the removal of the engines. On several occasions, 155-mm. guns were repaired on position without loss of time to the weapons. On one occasion, the maintenance officer was informed at 10:30 A.M. that a 155-mm. gun limber was hopelessly flattened at the gun position. Artillery repair trucks and a welding truck were sent immediately to the gun position, the limber repaired, and the gun put in condition to move out with its unit at 2 P.M. the same day.

The repair on the road and in bivouac of a large number of scout cars, including the replacement of engines, transmissions, transfer cases, rear axles, springs, spring hangers, and tie rods was accomplished. Response was made to innumerable calls for welding, machine-shop work, and mechanics' skill on equipment other than that of Ordnance issue. Much of this work was done in a spirit of coöperation to keep the equipment of the corps in operation and to live up to the reputation of the Ordnance Department for rendering unselfishly skilled service.

The basic proof of success of any organization is determined by its results. Suffice it to say that there was no dead line of equipment awaiting repair, that all the Ordnance equipment of the corps, except one scout car damaged beyond economical repair, was in a serviceable condition at the conclusion of the field exercises, and that much of this equipment was in a better condition when it left Louisiana than when it arrived in the concentration area.

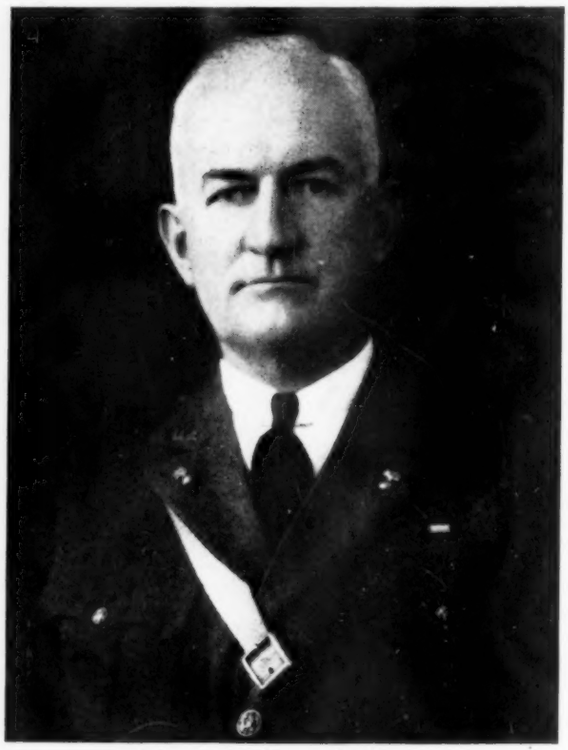
In conclusion, the lessons to be drawn by Ordnance from the April-May field exercises of the Third Army are as follows: (1) The concentration of maintenance troops with the corps provides for greater economy of force, greater economy of equipment, and more efficient operation; (2) The placing of the Ordnance battalion under the command of the corps Ordnance officer gives him the means of carrying out his responsibilities, facilitates the transmittal of orders, and provides for more efficient operation; (3) The location of the corps Ordnance officer is ordinarily at the forward echelon of corps headquarters; (4) The organization of the Ordnance battalion should include a group of well-balanced maintenance units each capable of supporting a combat unit of all arms; (5) The Ordnance battalion should include in its organization a heavy-maintenance company in order to make available certain essential tools and equipment.

# New Ordnance Strength

## Additional General Officers for Added Staff Responsibilities

BY nomination of the President on September 27, 1940, eight officers of the Ordnance Department were selected for promotion in the grades of general officer. This action, which also promoted more than a hundred officers of the entire Army, was taken to provide commanders of appropriate rank in the field forces of the Army and also to man with appropriate general-officer rank certain staff and procurement responsibilities which the expansion of the Army has created. Authority to advance officers to temporary rank for particular positions of command was recently authorized by the Congress.

The eight Ordnance officers chosen are all in positions of high responsibility: Maj. Gen. James H. Burns is executive officer to the Assistant Secretary of War, an office he has filled with distinction for the past four years; Brig. Gen. James K. Crain, chief of Field Service, Office of the Chief of Ordnance; Brig. Gen. John B. Rose, commanding officer, Aberdeen Proving Ground; Brig. Gen. H. K. Rutherford, chief of the Planning Branch, Office of the Assistant Secretary of War; Brig. Gen. R. H. Somers, chief of the Technical Staff, Office of the Chief of Ordnance; Brig. Gen. Burton O. Lewis, special assistant for production, Industrial Service, Office of the Chief of Ordnance; Brig. Gen. G. M. Barnes, special assistant for engineering, Industrial Service, Office of the Chief of Ordnance; and Brig. Gen. L. H. Campbell, Jr., special assistant for plant facilities, Industrial Service, Office of the Chief of Ordnance. Army Ordnance extends its felicitations to these new Ordnance generals and expresses abiding confidence, shared by all their friends, in their ability, energy, and zeal.

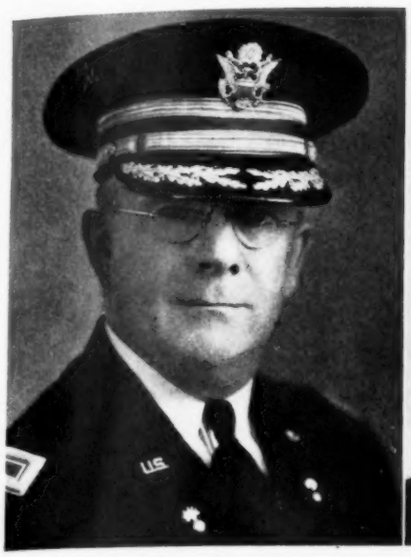


Maj. Gen. James H. Burns

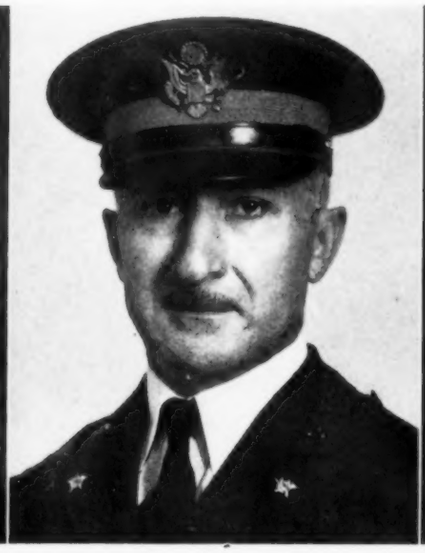
MAJ. GEN. JAMES H. BURNS, executive to the Assistant Secretary of War, was appointed to the United States Military Academy from New York and was graduated in the class of 1908. He was first commissioned a second lieutenant of Field Artillery, in which branch he served at the Presidio of San Francisco, Presidio of Monterey, Fort Sill, and Nashville. He began his service in the Ordnance Department at Sandy Hook Proving Ground and later served at the Picatinny Arsenal. He returned to the Field Artillery for service in Texas and Mexico, and in 1915 again was detailed with the Ordnance Department and returned to the Picatinny Arsenal. Early in the World War he served in the Office of the Chief of Ordnance at Washington and later in the office of the Chief Ordnance Officer, A.E.F. Subsequently he was Ordnance officer, Ninth Corps Area; commanding officer, Raritan Arsenal, and Ordnance officer, Philippine Department. Prior to his service as executive officer to the Assistant Secretary of War he was assigned to duty in the Office of the Chief of Staff. He was graduated from the Army Industrial College in 1926 and the Army War College in 1927.

For his World War service General Burns was awarded the Distinguished Service Medal with the following citation: "First as chief of the Explosives Branch, Design Section, Gun Division, in which capacity he was charged with the production of sufficient explosives, propellants, and shell loading for the needs of the American Government and her Allies; and later as chief of the Explosives Section, Production Division, with securing the necessary production of explosives, propellants, and assembly of ammunition to meet the needs of America in the World War."

BRIG. GEN. JAMES K. CRAIN, chief of Field Service, Office of the Chief of Ordnance, was appointed to the United States Military Academy from Texas and was graduated in the class of 1904. He was first commissioned a second lieutenant of Artillery, serving at Fort Moultrie, Fort Monroe, Manila, and Galveston. He was instructor, department of tactics, United States Military Academy, and then served with the Coast Artillery at Fort Barrancas and Fort Screven. Prior to his assignment to duty as Chief Ordnance Officer, 42nd Division, during the World War, he was assistant to the Chief of Coast Artillery at Washington. He served as Chief Ordnance Officer of the 42nd Division, A.E.F., and successively thereafter was Chief Ordnance Officer, First Army Corps; Chief Ordnance Officer, Second Army; and Chief Ordnance Officer, Third Army, and American Forces in Germany. While serving in France he participated in the Aisne-Marne, St.-Mihiel and Meuse-Argonne offensives and the Champagne-Marne defensive. Upon his return to the United States he became chief of the Ammunition Division, Office of the Chief of Ordnance. General Crain was graduated from the Army War College and assumed command of the Picatinny Arsenal. He then returned to Washington for duty as director of current procurement, Office of the Assistant Secretary of War, during part of



BRIG. GEN. RICHARD H. SOMERS



BRIG. GEN. JOHN B. ROSE

BRIG. GEN. JAMES K. CRAIN

which tour he was also executive officer. He then was ordered to Fort Sam Houston for duty as Ordnance officer, Eighth Corps Area, until July 1939.

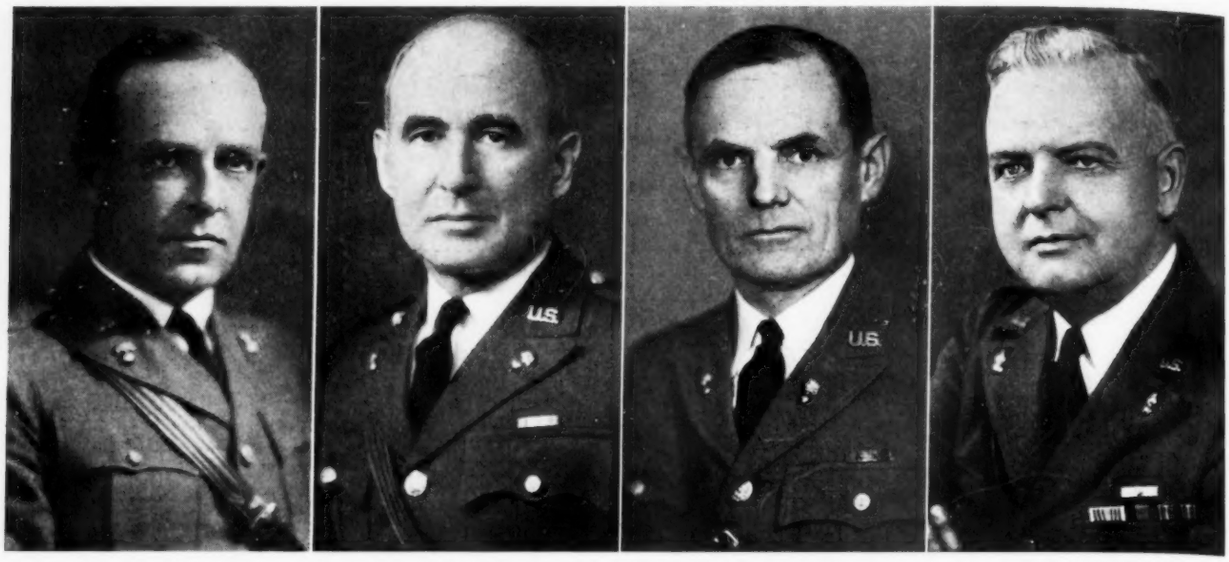
General Crain was awarded the Distinguished Service Medal with the following citation: "Successively as Ordnance officer of the 42nd Division, First Army Corps and Second Army, he displayed exceptional ability in the organization and administration of work of great magnitude. Encountering unforeseen and perplexing problems, he solved them with initiative and sound judgment, showing a full understanding of existing needs and conditions of the service. He was tireless in energy and resourceful, proving at all times devoted to his important duties."

BRIG. GEN. JOHN B. ROSE, commanding officer, Aberdeen Proving Ground, a native Virginian, was graduated from West Point in 1907. First commissioned in the Coast Artillery Corps, he began his Ordnance service as proof officer and student in the Ordnance School at the Sandy Hook Proving Ground. After service in the maintenance of artillery armament of the New England coast, he was redetailed to the Ordnance Department for duty in the Carriage Division in charge of design and maintenance of seacoast armament. Later he was successively in charge of the Antiaircraft Section, Engineering Division, and the Mobile Gun Carriage Section. Gun carriages designed in the Antiaircraft Section reached France in late 1917 in advance of any other American war-built artillery.

Upon his return to the United States after the World War, he attended the field officers' course at Fort Monroe and was graduated from the Command and General Staff School at Fort Leavenworth. Subsequently he was chief of the Artillery Division, Office of the Chief of Ordnance, and later works manager of the Watertown Arsenal. He commanded the Picatinny Arsenal and served as Department Ordnance Officer, Panama Canal Zone. Prior to his present tour as commanding officer of the Aberdeen Proving Ground, begun in July 1939, he served a 4-year tour with the War Department General Staff in the G-4 division.

BRIG. GEN. HARRY K. RUTHERFORD, director, Planning Branch, Office of the Assistant Secretary of War, was appointed to the Military Academy from his native state, New York, and upon graduation in 1907 was commissioned a second lieutenant of Coast Artillery. His Ordnance service began at the Sandy Hook Proving Ground where he was successively a student officer, proof officer, and armament officer. Throughout the World War he held the important rôle of officer in charge of fire-control design at the Frankford Arsenal. He also was graduated from the Army Industrial College and the School of Business Administration, Harvard University. Following his graduation from Harvard, he became dean of the faculty of the Army Industrial College incident to a 4-year tour of duty in the Office of the Assistant Secretary of War. After service as Ordnance officer of the Hawaiian Department, he became executive officer of the New York Ordnance District. During this period, he was on temporary duty with the National Recovery Administration. After a brief assignment as commanding officer of the Raritan Arsenal, General Rutherford returned to the Office of the Assistant Secretary of War as secretary of the Army and Navy Munitions Board. As head of the Planning Branch he is also a member of the Joint Army and Navy Planning Committee and secretary of the War Resources Board.

BRIG. GEN. R. H. SOMERS, chief of the Technical Staff, Office of the Chief of Ordnance, was graduated from the United States Military Academy, a member of the class of 1907, having been appointed from New Jersey, his native state. He was first commissioned a second lieutenant of Coast Artillery and began his Ordnance service at the Sandy Hook Proving Ground. He was assistant professor of ordnance and gunnery at the Military Academy. When the Aberdeen Proving Ground was begun, he was one of the first officers of its staff and also commandant of the Ordnance School of Application at that station. While on duty in the Office of the Chief of Ordnance from 1921 to 1924, he was also secretary of the Army Ordnance Association and editor of ARMY ORDNANCE. Both the society and its journal prospered under his leadership. Following graduation from the Army Industrial College in 1924 he became executive officer of that institution. He was graduated from the Graduate School of Business Administration, Harvard University, and was ordered to the Massachusetts Institute of Technology at Cam-



BRIG. GEN. L. H. CAMPBELL BRIG. GEN. H. K. RUTHERFORD BRIG. GEN. G. M. BARNES BRIG. GEN. B. O. LEWIS

bridge, Mass., as assistant professor of military science and tactics. He then served a 4-year tour as chief of the Artillery Division, Office of the Chief of Ordnance. He was Ordnance officer, Panama Canal Department, prior to his becoming commanding officer of the Watervliet Arsenal in September 1938, which post he held until his transfer to Washington three months ago to become chief of the Technical Staff.

BRIG. GEN. BURTON O. LEWIS, special assistant for production, Industrial Service, Office of the Chief of Ordnance, is a native of Cleveland, Ohio. He was graduated from the United States Military Academy, class of 1910, and served first in the Field Artillery. He was detailed to the Ordnance Department for a period of four years in 1912 for duty at the Rock Island Arsenal as assistant to the officer in charge of manufacture. Later he was graduated from the Ordnance School of Technology at Watertown Arsenal, and the following year was graduated from the Ordnance School of Application, Sandy Hook Proving Ground. He returned to the Field Artillery and was on duty on the Mexican border with the 7th Field Artillery. While with this regiment he was assigned as division Ordnance officer of the 14th Provisional Infantry Division encamped at San Antonio and served as assistant to Maj. Gen. (then Lieut. Col.) C. C. Williams, Ordnance officer of the Southern Department of the Army.

During the World War he served in the Field Artillery Section, Carriage Division, and as chief of the Automatic Supply Section of the Supply Division. He then was ordered to France where he served in the Engineering Division, Office of the Chief Ordnance Officer, A.E.F., and later as executive assistant to the Chief Ordnance Officer, the late Brig. Gen. John H. Rice. Subsequently he served in the Office of the Chief of Ordnance, at the Aberdeen Proving Ground, Fort Eustis, and at the Rock Island Arsenal. He was on duty with the Mechanized Force, and Ordnance officer of the Fourth Corps Area. He was graduated from the Army Industrial College in 1929 and from the Army War College in 1939. Prior to his present assignment General Lewis was on duty at the Aberdeen Proving Ground in charge of the proof department. For his World War service he was awarded the Purple Heart.

BRIG. GEN. G. M. BARNES, special assistant for engineering, Office of the Chief of Ordnance, was born in Michigan and was graduated from the University of Michigan, a bachelor of civil engineering, in 1910. In the same year he was appointed a second lieutenant of Coast Artillery. Detailed to the Ordnance Department, he served at the Watertown Arsenal, Frankford Arsenal, and Sandy Hook Proving Ground. Shortly after the entrance of the United States into the World War he was assigned to duty in the Office of the Chief of Ordnance as chief of the section charged with the design of railway artillery and seacoast matériel. Subsequently he was assistant Ordnance officer of the American Forces in Germany. Upon his return to the United States he was on duty as chief of the Railway, Seacoast, and Cannon Section of the Artillery Division. Later he was made chief of the Antiaircraft Section. Thereafter his service included engineering and design at Aberdeen Proving Ground and Watertown Arsenal. He was graduated from the Army Industrial College in 1936 and was assigned to procurement-planning duty in the Office of the Assistant Secretary of War. He was graduated from the Army War College in 1938.

BRIG. GEN. L. H. CAMPBELL, JR., special assistant for plant facilities, Ordnance Office, a native Washingtonian, was graduated from the United States Naval Academy, class of 1909. He was commissioned in the Coast Artillery Corps of the Regular Army and began his service in the Ordnance Department during the World War. Thereafter he specialized in the production of artillery matériel at the Holt Manufacturing plant, Stockton, Calif. He was proof officer in charge of automotive testing at the Aberdeen Proving Ground and officer in charge of design at the Rock Island Arsenal. Subsequently he was in charge of the Automotive Section, Artillery Division, Office of the Chief of Ordnance. He then returned to the Rock Island Arsenal as officer in charge of manufacture, leaving that post to assume charge of the artillery ammunition department at the Frankford Arsenal where he modernized the art of quantity production in conformity with latest principles of production engineering. This latter assignment he held until he was ordered to his present station at Washington as assistant chief of the Industrial Service.

# Rearmament Progress

## Statistics of the Current Program*

*The following list includes ordnance production contracts ($25,000 and above) placed with private industry from July 16 to September 30, 1940; it does not include orders placed with the arsenals.*

### Artillery Matériel and Components

| *Facility* | *Amount* |
|---|---|
| Aetna-Standard Engineering Co., Youngstown, Ohio | $ 1,703,050.24 |
| American Hollow Boring Co., Erie, Pa | 133,311.36 |
| American Locomotive Co., New York, N. Y | 6,175,596.00 |
| Bausch & Lomb Optical Co., Rochester, N. Y | 1,147,970.20 |
| Brill Co., J. G., Philadelphia, Pa | 148,060.08 |
| Builders Iron Foundry, Providence, R. I | 29,501.00 |
| Byron Jackson Co., Los Angeles, Calif | 2,643,709.88 |
| Colt's Patent Fire Arms Manufacturing Co., Hartford, Conn | 6,951,716.00 |
| Crucible Steel Co. of America, New York, N. Y | 143,472.75 |
| Curley Co., W. & L. E., Troy, N. Y | 255,312.00 |
| Dayton Rubber Manufacturing Co., Dayton, Ohio | 49,140.00 |
| Dickgiesser & Co., Charles J., Derby, Conn | 36,852.60 |
| Duplex Printing Co., Battle Creek, Mich | 6,097,440.00 |
| Eastman Kodak Co., Rochester, N. Y | 25,290.30 |
| Eclipse Aviation Division (Bendix Aviation Corporation), Bendix, N. J | 43,331.00 |
| Eclipse Machine Division (Bendix Aviation Corporation), Elmira, N. Y | 2,545,000.00 |
| Gar Wood Industries, Inc., Detroit, Mich | 3,784,364.00 |
| General Electric Co., Schenectady, N. Y | 2,380,916.04 |
| Gilbert & Barker Manufacturing Co., Springfield, Mass | 883,868.82 |
| Hannifin Manufacturing Co., Chicago, Ill | 244,061.35 |
| Hoe & Co., R., New York, N. Y | 3,746,750.20 |
| International Nickel Co., Huntington, W. Va | 184,030.10 |
| Kennedy Van-Saun Manufacturing Co., Danville, Pa | 638,274.15 |
| Keuffel & Esser Co., New York, N. Y | 1,602,991.40 |
| Maxson Corporation, W. L., New York, N. Y | 106,589.50 |
| Mergenthaler Linotype Co., Brooklyn, N. Y | 231,333.65 |
| Mesta Machine Co., Pittsburgh, Pa | 8,390,000.00 |
| Midvale Co., Philadelphia, Pa | 1,361,388.00 |
| Miller Printing Machinery Co., Pittsburgh, Pa | 1,240,668.00 |
| National Forge & Ordnance Co., Irvine, Pa | 157,610.80 |
| National Pneumatic Co., Rahway, N. J | 5,763,753.93 |
| Parish Pressed Steel Co., Reading, Pa | 1,427,296.00 |
| Pennsylvania Forge Corporation, Philadelphia, Pa | 185,275.00 |
| Pettibone Mulliken Corporation, Chicago, Ill | 3,817,884.00 |
| Pullman-Standard Car Manufacturing Co., Chicago, Ill | 6,613,725.00 |
| Safety Car Heating & Lighting Co., Inc., New York, N. Y | 129,396.09 |
| Struthers Wells-Titusville Corporation, Titusville, Pa | 443,153.00 |
| Timken-Detroit Axle Co., Detroit, Mich | 1,614,309.35 |
| Vilter Manufacturing Co., Milwaukee, Wis | 1,040,200.33 |
| Warner Electric Brake Manufacturing Co., Beloit, Wis | 28,752.17 |
| Wheland Co., Chattanooga, Tenn | 2,412,800.00 |
| York Safe & Lock Co., York, Pa | 3,633,918.97 |

### Artillery Ammunition and Components

| | |
|---|---|
| American Brass Co., Waterbury, Conn | $ 27,149.00 |
| American Forge Division (American Brake Shoe & Foundry Co.) Chicago, Ill | 244,110.00 |
| American Steel & Wire Co., Cleveland, Ohio | 62,382.65 |
| Auto Specialties Manufacturing Co., St. Joseph, Mich | 1,653,750.00 |

*For orders placed prior to July 15, 1940, see the September-October issue of ARMY ORDNANCE (Vol. XXI, No. 122, p. 129).

# Ordnance Production Contracts—Fiscal Year 1941

| *Facility* | *Amount* |
|---|---|
| Bendix Aviation Corporation, Bendix, N. J | $10,140,000.00 |
| Benrus Watch Co., Inc., New York, N. Y | 33,000.00 |
| Bethlehem Steel Co., Bethlehem, Pa | 26,344.50 |
| Bohn Aluminum & Brass Corporation, Detroit, Mich | 172,471.30 |
| Braun Gear Corporation, Brooklyn, N. Y | 95,329.27 |
| Budd Manufacturing Co., Edward G., Philadelphia, Pa | 2,704,026.00 |
| Budd Wheel Co., Detroit, Mich | 4,076,000.18 |
| Carbide & Carbon Chemicals Corporation, South Charleston, W. Va | 27,500,00 |
| Chase Brass & Copper Co., Waterbury, Conn | 4,117,574.87 |
| Cleveland Container Co., Philadelphia, Pa | 150,363.99 |
| Colorado Fuel & Iron Corporation, Pueblo, Colo | 4,536,000.00 |
| Crosby Co., Buffalo, N. Y | 1,160,000.00 |
| Delco Products Division (General Motors Corporation) Dayton, Ohio | 110,114.79 |
| Doehler Die Casting Co., Pottstown, Pa | 141,946.70 |
| Duplan Silk Corporation, New York, N. Y | 49,140.66 |
| Du Pont de Nemours & Co., Inc., E. I., Wilmington, Del. (plants) | 19,000,000.00 |
| Eclipse Machine Division (Bendix Aviation Corporation) Elmira, N. Y | 88,570.00 |
| Federal Screw Works, Detroit, Mich | 32,622.30 |
| General Motors Corporation, Anderson, Ind | 1,057,500,00 |
| General Motors Corporation, Detroit, Mich | 11,920,600.00 |
| Gibbs & Co., Thomas S., Chicago, Ill | 37,500.00 |
| Harvey Metal Corporation, Chicago, Ill | 236,730.00 |
| Hercules Powder Co. (plants) | 16,075,000.00 |
| Kilby Steel Co., Anniston, Ala | 694,000.00 |
| Kilgore Manufacturing Co., Tippecanoe City, Ohio | 163,200.00 |
| Lansdowne Steel & Iron Co., Morton, Pa | 133,518.25 |
| Lonsdale Co., Providence, R. I | 80,793.43 |
| Mueller Co., Port Huron, Mich | 1,008,655.00 |
| Murray Manufacturing Corporation, Brooklyn, N. Y | 902,000.00 |
| National Fireworks Inc., West Hanover, Mass | 81,180.00 |
| National Malleable Steel & Casting Co., Cleveland, Ohio | 1,470,000.00 |
| National Pneumatic Co., New York, N. Y | 193,219.50 |
| National Tube Co., Pittsburgh, Pa | 52,276.75 |
| New Jersey Fulgent Co., Metuchen, N. J | 53,280.00 |
| Norris Stamping & Manufacturing Co., Los Angeles, Calif | 2,029,866.00 |
| Oil Well Supply Co., Oil City, Pa | 246,262.50 |
| Oliver Farm Equipment Co., Springfield, Ohio | 764,000.00 |
| Omaha Steel Works, Omaha, Nebr | 2,462,500.00 |
| Peco Manufacturing Co., Philadelphia, Pa | 234,000.00 |
| Pollak Manufacturing Co., Arlington, N. J | 955,350.00 |
| Pressed Steel Car Co., Chicago, Ill | 2,191,000.00 |
| Ravenna Ordnance Works, Ravenna, Ohio | 28,000,000.00 |
| Robertshaw Thermostat Co., Youngwood, Pa | 2,195,168.78 |
| Sanderson & Porter (plant, Wilmington, Ill.) | 13,615,000.00 |
| Schoettle Co., Edwin J., Philadelphia, Pa | 33,565.00 |
| Schweitzer-Cummins Co., Indianapolis, Ind | 1,596,695.00 |
| Scovill Manufacturing Co., Waterbury, Conn | 2,101,685.00 |
| Scripto Manufacturing Co., Atlanta, Ga | 1,094,000.00 |
| Seeley Tube & Box Co., Newark, N. J | 2,231,149.06 |
| Seth Thomas Clocks Division (General Time Instrument Co.), Thomaston, Conn | 103,347.00 |
| Standard Forgings Co., Chicago, Ill | 624,000.00 |
| Stewart-Warner Corporation, Chicago, Ill | 2,114,291.84 |
| Townsend Lawn Mower Co., Samuel P., Bloomfield, N. J | 34,572.00 |
| Tredegar Co., Richmond, Va | 99,855.50 |
| Walworth Co., Kewanee, Ill | 1,664,250.00 |
| Westclox Division (General Time Instrument Co.), La Salle, Ill | 225,111.70 |
| Western Cartridge Co., East Alton, Ill. (plant) | 15,000,000.00 |
| York Safe & Lock Co., York, Pa | 121,797.25 |

## Small-Arms Matériel and Components

| | |
|---|---|
| American Brass Co., Waterbury, Conn | $ 153,353.00 |

# Ordnance Production Contracts—Fiscal Year 1941

| *Facility* | *Amount* |
|---|---|
| Auto-Ordnance Corporation, New York, N. Y. | $ 506,812.31 |
| General Motors Corporation (including plants at Saginaw, Dayton, and Flint) | 80,398,872.19 |
| Lite Manufacturing Co., New York, N. Y. | 573,580.30 |
| Mark Co., Inc., S. B., New York, N. Y. | 115,240.00 |
| McCulloch Manufacturing Co., South Boston, Mass. | 27,902.61 |
| Savage Arms Corporation, Utica, N. Y. (including plant) | 44,883,113.50 |
| Uchtorff Co., Davenport, Iowa | 34,367.54 |

## Small-Arms Ammunition and Components

| | |
|---|---|
| Allegheny Ludlum Steel Corporation, Watervliet, N. Y. | $ 42,777.21 |
| Barnard Aviation Equipment Co., Inc., Ashley, Pa. | 928,550.00 |
| Bethlehem Steel Co., Bethlehem, Pa. | 42,982.80 |
| Carpenter Steel Co., Reading, Pa. | 42,845.73 |
| Crucible Steel Co. of America, New York, N. Y. | 42,845.73 |
| Hershey Metal Products, Inc., Derby, Conn. | 45,600.00 |
| Remington Arms Co., Bridgeport, Conn. (including plant) | 103,700,000.00 |
| Standard Pressed Steel Co., Jenkintown, Pa. | 290,190.00 |
| Western Cartridge Co., East Alton, Ill. | 90,990,837.50 |

## Bombs, Pyrotechnics and Components

| | |
|---|---|
| American Car & Foundry Co., New York, N. Y. | $ 39,200.00 |
| Budd Manufacturing Co., Edward G., Philadelphia, Pa. | 847,443.18 |
| Eastern Tool & Manufacturing Co., Bloomfield, N. J. | 43,500.00 |
| Essex Specialty Co., Inc., Berkeley Heights, N. J. | 344,920.00 |
| Harrisburg Steel Corporation, Harrisburg, Pa. | 265,000.00 |
| Hemp & Co., Macomb, Ill. | 76,959.14 |
| Hollister, S. C., New York, N. Y. | 37,368.00 |
| Hudson Motor Car Co., Detroit, Mich. | 143,824.00 |
| Kilgore Manufacturing Co., Tippecanoe City, Ohio | 112,100.00 |
| Mack Molding Co., Inc., Wayne, N. J. | 121,371.50 |
| Magna Manufacturing Co., Inc., Haskell, N. J. | 34,242.00 |
| Norris Stamping & Manufacturing Co., Los Angeles, Calif. | 187,842.00 |
| Rheem Manufacturing Co., Chicago, Ill. | 326,541.00 |
| Saginaw Stamping & Tool Co., Saginaw, Mich. | 272,700.00 |
| Swanson Machine Co., Jamestown, N. Y. | 87,320.42 |
| Triumph Explosives, Inc., Elkton, Md. | 67,410.00 |
| Thorrez & Maes Manufacturing Co., Jackson, Mich. | 161,250.00 |
| United States Automatic Corporation, Amherst, Ohio | 35,127.00 |

## Powder, Explosives and Loading

| | |
|---|---|
| American Cyanamid & Chemical Corporation, Maynard, Mass. | $ 53,375.00 |
| Atlas Powder Co., Atlas, Mo. | 514,750.00 |
| Atlas Powder Co., Wilmington, Del. (plant) | 13,000,000.00 |
| Du Pont de Nemours & Co., Inc., E. I., Wilmington, Del. | 1,161,301.00 |
| Du Pont de Nemours & Co., Inc., E. I. (including plant, Charlestown, Ind.) | 70,000,000.00 |
| Du Pont de Nemours & Co., Inc., E. I. (including plant, Wilmington, Ill.) | 26,000,000.00 |
| Hercules Powder Co., Kenvil, N. J. | 843,800.00 |
| Hercules Powder Co., Wilmington, Del. | 18,693,360.20 |
| Humble Oil & Refining Co., Houston, Tex. (plant) | 12,000,000.00 |
| Improved Mailing Case Co., Inc. New York, N.Y. | 27,804.00 |
| Indiana Ordnance Works, Charlestown, Ind. | 23,050,000.00 |
| Radford Ordnance Works, Radford, Va. | 24,550,000.00 |
| Solvay Process Co., New York, N. Y. (plant) | 11,000,000.00 |
| Trojan Powder Co., Allentown, Pa. (plant) | 13,000,000.00 |

## Combat Vehicles, Automotive Equipment and Accessories

| | |
|---|---|
| Allis-Chalmers Co., Milwaukee, Wis. | $ 1,918,200.00 |
| American Car & Foundry Co., New York, N. Y. | 60,206,469.00 |
| American Locomotive Co., New York, N. Y. | 32,070,000.00 |
| American Steel Foundries, Chicago, Ill. | 179,787.60 |

# Ordnance Production Contracts—Fiscal Year 1941

| *Facility* | *Amount* |
|---|---|
| Autocar Co., Ardmore, Pa | $16,852,509.00 |
| Baldwin Locomotive Works, Philadelphia, Pa | 33,675,225.00 |
| Chrysler Corporation, Detroit, Mich | 33,500,000.00 |
| Cleveland Tractor Co., Cleveland, Ohio | 39,672.00 |
| Columbus Bolt Works Co., Columbus, Ohio | 32,480.00 |
| Continental Motors Corporation, Muskegon, Mich | 21,221,691.74 |
| Diamond T Motor Co., Chicago, Ill | 104,584.00 |
| Disston & Sons, Inc., Henry, Philadelphia, Pa.(including plant) | 1,089,586.87 |
| Firestone Tire & Rubber Co., Akron, Ohio | 102,740.00 |
| Goodrich Rubber Co., B. F., Akron, Ohio | 1,409,439.00 |
| Guiberson Diesel Engine Co., Dallas, Tex | 2,915,255.86 |
| Saginaw Stamp & Tool Co., Saginaw, Mich | 234,562.00 |
| Transue & William Steel Forging Corporation, Alliance, Ohio | 221,373.00 |
| Ward LaFrance Truck Corporation, Elmira, N. Y | 629,901.00 |
| Weaver Manufacturing Co., Springfield, Ill | 41,720.00 |
| White Motor Co., Cleveland, Ohio | 39,942,437.80 |
| Wright Aëronautical Corporation, Paterson, N. J | 3,121,680.00 |
| **Fire Control** | |
| Barnard Aviation Equipment Co., Inc., Ashley, Pa | $ 90,898.98 |
| Bausch & Lomb Optical Co., Rochester, N. Y | 1,170,215.20 |
| Bell & Howell Co., Chicago, Ill | 322,512.48 |
| Eastman Kodak Co., Rochester, N. Y | 105,946.20 |
| Sperry Gyroscope Co., Inc., Brooklyn, N. Y | 10,719,357.96 |
| **Tools and Machinery** | |
| Acme Machinery Co., Cleveland, Ohio | $ 27,384.00 |
| Austin-Hastings Co., Inc., Cambridge, Mass | 107,703.40 |
| Barnes Co., W. F. & John, Rockford, Ill | 64,197.40 |
| Bliss Co., E. W., Brooklyn, N. Y | 76,550.00 |
| Brown & Sharpe Manufacturing Co., Providence, R. I | 363,679.96 |
| Bullard Co., Bridgeport, Conn | 136,614.18 |
| Chambersburg Engineering Co., Chambersburg, Pa | 40,302.00 |
| Cincinnati Milling Machine Co., Cincinnati, Ohio | 264,223.17 |
| Essley Machinery Co., E. L., Chicago, Ill | 58,471.00 |
| General Electric Co., Schenectady, N. Y | 96,946.00 |
| General Machinery Corporation, Hamilton, Ohio | 172,500.00 |
| Giddings & Lewis Machine Tool Co., Fond Du Lac, Wis | 67,005.00 |
| Gisholt Machine Co., Madison, Wis | 29,316.00 |
| Gray Co., G. A., Cincinnati, Ohio | 59,909.17 |
| Jones & Lamson Machine Co., Springfield, Vt | 28,835.00 |
| Kearney & Trecker Corporation, Milwaukee, Wis | 37,450.00 |
| Krueger & Co., H. R., Detroit, Mich | 51,435.00 |
| Lapointe Machine Tool Co., Hudson, Mass | 140,151.35 |
| LeBlond Machine Tool Co., R. K., Cincinnati, Ohio | 108,911.20 |
| Logansport Machine, Inc., Logansport, Ind | 44,200.00 |
| Marshall & Huschart Machine Co., Chicago, Ill | 204,329.00 |
| National Acme Co., Cleveland, Ohio | 35,272.60 |
| Pratt & Whitney Division (Niles-Bement-Pond Co.), Hartford, Conn | 435,106.75 |
| Prentiss & Co., Henry, Boston, Mass | 76,134.00 |
| Rockwell Co., W. S., New York, N. Y | 101,282.00 |
| Sellers & Co., Inc., William, Philadelphia, Pa | 36,675.00 |
| Thompson Grinder Co., Springfield, Ohio | 46,200.00 |
| United States Tool Co., Inc., Ampere, N. J | 29,510.00 |
| Warner & Swasey Co., Cleveland, Ohio | 32,475.00 |
| **Gages** | |
| Barwood & Co., Philadelphia, Pa | $ 76,522.00 |
| Greenfield Tap & Die Corporation, Greenfield, Mass | 61,420.05 |
| Modern Tool & Die Co., Philadelphia, Pa | 32,220.00 |
| Vinco Corporation, Detroit, Mich | 175,096.97 |
| Waterbury Farrel Foundry & Machine Co., Waterbury, Conn | 30,000.00 |

# Armament Production

## A Study of Ordnance Engineering Policies

TIME is priceless in modern national defense. Time saved in preparation for defense can be translated directly into battles won. Time lost can be accountable for defeat of otherwise brilliant leadership. Time lost has routed more armies than bad weather. Time has no synonym in the lexicon of preparedness. Time is decidedly of the essence of defense.

The time factor in military effectiveness cannot be overemphasized. It applies with equal severity to the drafting board, the laboratory, the factory, and the field of battle. Minutes are as priceless in the intricacies of the manufacturing plant as they are in the maneuver of field forces. The greatest single factor in saving time, in so far as the manufacture of military armament is concerned, is the insistence upon sound production practices in the design and manufacture of the weapons for our fighting forces. It is the purpose of this paper to describe the policies and some of the production engineering practices as they have been developed and as they are now being applied in the Ordnance Department of the Army. Production engineering of ordnance—or the ability to produce weapons quickly—is a strong guarantee that priceless time will be saved.

*THIS study, compiled at the direction of Brig. Gen. C. T. Harris, Jr., Assistant to the Chief of Ordnance, is a companion piece to "The Research and Development Activities of the Ordnance Department, United States Army" prepared last spring by Brig. Gen. G. M. Barnes, Ord. Dept., U. S. Army. That analysis presented a comprehensive survey of the policies and practices governing the Department in its research and development problems. General Barnes' study was prepared in order that scientists, engineers, and industrialists might know what the Ordnance Department is doing to keep pace with scientific and commercial progress. It is felt that a similar survey of our production policies and our production engineering practices as they relate to the weapons of our Army will serve the same useful purpose. The Ordnance Department has the responsibility, under law, for the adequacy of our armament in quantity and quality to meet our military needs.*—EDITOR.

IT is difficult to draw an exact line of demarcation between development and production engineering. In Ordnance Department practice, production characteristics of the item underlie all phases of design. From the very beginning of a development project, prospective difficulties in manufacture which might delay production are overcome as much as possible. Furthermore, in the Department there is a definite rule that commercial products and commercial practices must underlie all Ordnance Department designs. Commercial standards are not to be departed from except in extraordinary circumstances.

This philosophy has predominated in the Department for many years. Its great spokesman was Maj. Gen. C. C. Williams, Chief of Ordnance from 1918 to 1930. The Williams' Rule can be paraphrased thus: "Make certain to use every practice and every product of American industry in the design and manufacture of our military armament in as far as possible and, conversely, create special designs and special practices only when industry has no counterpart either in method or in product."

Inasmuch as the manufacture of ordnance consists almost entirely of the utilization of peace-time methods and products for military use, there are few occasions when the Williams' Rule cannot be followed to the letter. The degree of production engineering in the Ordnance Department is thus in proportion to the coöperation existing between the Department and private industry.

A basic factor in the production-engineering policies of the Ordnance Department is the wider military axiom of equipment standardization. The axiom is: Inasmuch as the principles of standardization and simplification lie at the root of American industrial and commercial supremacy, these principles likewise are essential to all branches of armament production in peace and in war. Standardization has been defined as "the unification of the methods, practices, and technique involved in the manufacture, construction, and use of materials, machines, and products, and in all lines of endeavor which prevent the necessity for performing repetitive operations."

One of the duties of the Office of the Assistant Secretary of War is to see to it that all military equipment, in as far as possible, is made from commercial materials by commercial processes and is adaptable to mass-production methods. The Assistant Secretary's office clears all specifications which are presented by the supply arms and services, and in so doing demands general conformity with commercial practice. The office is represented in the American Standards Association; it coöperates with the Department of Commerce and the Bureau of Standards and other technical organizations.

THE Ordnance Department, as is the case with other supply arms and services of the Army, is guided by definite rules in formulating its military requirements. Nonessentials which are costly in time and wasteful of money must be omitted; noncommercial items or parts must not be specified except in extraordinary circumstances; types must not be such as would delay or complicate procurement. The Ordnance Department has its book of standards; it has its drawings and specifications for these standards and substitute standards; it has its technical committees; it makes full use of commercial articles or slightly modified commercial articles; it keeps the requirement of quantity production uppermost throughout the entire process of design. In preparing its specification, the Department makes full use of Federal specifications, the standards of national technical societies, and commercial practice.

To these policies, basic in the Ordnance Department, are

attributable much of the progress that has been made in our readiness for the mass production of armament. The Department itself takes pride in its share in the very beginnings of mass production in our country. Interchangeability of manufacture—and hence mass production—was a pioneer achievement of the New England arms makers. The Springfield Armory, now in its one hundred and forty-eighth year, has its share in this record of interchangeable manufacture. It is a stimulating tradition of peace-time achievement and war-time assurance.

Probably the best criterion of the stability of production engineering practices in the Ordnance Department is the close coöperation which exists between the Department and the machine-tool industry. Production engineering and modern machine tools are complementary terms. When modern machine-tool practices predominate, sound production engineering prevails.

As a gauge of the degree in which modern production engineering practices are applied, consider the three principal categories of ordnance manufacture. These categories are (1) artillery, including automotive combat vehicles, (2) ammunition and bombs, and (3) small arms. The design and manufacture of all these are essentially metallurgical problems. A score of firms of national prominence have aided materially in the solution of the metallurgical problems of the Ordnance Department.

Today the semiautomatic rifle, sometimes called the Garand, officially known as the U. S. rifle, M1, is an outstanding example of the utilization of production engineering. Impatience occasionally has been shown in many quarters with the amount of time required to bring this rifle to maximum production. Inherent difficulties, which always are encountered in the early stages of new manufacture—especially where operations and tolerances are as exacting as they are in this piece—were present in the Garand. Many of these delays were due to the lack of, and the delay in, obtaining adequate modern machine tools. A detailed record of the various steps taken at the armory, looking toward quantity production, will show how painstakingly the mass-production problem of the rifle was undertaken once the new rifle was adopted as the standard for our Army. The following is from a lecture by an Ordnance officer* who had been in close touch with the production engineering of the rifle and who served at the Springfield Armory during an important part of the process of retooling and initial manufacture:

"The armory administration was immediately confronted (when retooling for the production of the Garand was begun; *i.e.*, shortly after the rifle was adopted as standard for the Army) with the necessity for setting up an almost new production unit. The order of procedure was about as follows: To prepare *production drawings* of the article to be produced. In reference to production drawings, I differentiate between that type and preliminary, or model-room, drawings in which dimensions may be given flatly without tolerances being specified. It is perfectly feasible to use drawings which show no variation from a flat dimension in a model room where the degree of accuracy which may be expected approaches that of the gage maker's practice. A production drawing must meet an entirely different requirement. It is essential that it be carefully reviewed from the standpoint of the necessity for interchangeable manufacture. All dimensions must be expressed with a suitable tolerance so related to every other dimension on a single component as to hold to a very definitely known relation which may be expected to exist in each component and between mating surfaces of related components.

"A production drawing must be considered very carefully by a competent engineer to insure that all dimensions are properly measured from certain important surfaces which serve as holding points, or locating points, while work is in process. As these locating points are machined away, subsequent operations must be dimensioned from other surfaces in order to have the finished dimensions definitely related one to another, otherwise interchangeability cannot be obtained. This condition may be clearly illustrated by the example of a drilled hole into which a plug must be inserted. The production part having the smallest drilled hole must be large enough to receive the plug having the greatest diameter.

"Having made production drawings, it next became necessary to determine how each component of an assembled article was to be processed. This is normally called the sequence of operations. Once having been determined, the procedure as established forms a production engineer's bible known as the 'book of route sheets.' Each step through which a component must go from its initial operation to its finished state is shown on the route sheet related to it. The type of material, its heat treatment, and a definite measurement of its physical characteristics must be stated. The route sheet also must show for each operation the manner in which it shall be performed, the type of machine, fixture number when a fixture is required, and the designation of the gages to be used to measure the accuracy of the operation.

"Route sheets having been prepared, it next became necessary to determine the quantity of material that was required to cover a given order. The material then was placed in stock, this procedure sometimes requiring several months, since all purchases of this nature are made on a competitive basis and consequently require the usual periods for advertisement, determination of awards, and times of delivery.

"In the meantime, plans were made to route work into the production shops. This was done by a unit called the Production Control Section of the Planning Division and was accomplished by the issuance of orders to the shops for processing a definite number of components through all operations in such quantities as could be reasonably handled without too much interruption of the flow of work, always with an eye to the arrival of approximately the same quantities of major components in the assembly room to enable complete assembly to be accomplished. Naturally, the greater the number of components in process, the more complex is the production-control problem.

"Not so long ago at Springfield Armory, when that establishment not only was producing the Garand rifle in small quantities but also was carrying many miscellaneous parts on a jobbing-shop basis, there were fourteen thousand separate suborders in the production shops calling for work on different operations which had to be accounted for and scheduled by the shop production control. The suborders also prescribe how much each group of operations shall cost and how many machine hours may be consumed in the process.

"While all this preliminary work was being done in one

* "Ordnance Production Difficulties and Their Solutions," by Lieut. Col. James L. Hatcher, Ord. Dept.: a lecture before the Army Industrial College.

section, another was busy determining what the procedure of manufacture was to be, the capacity of the machines to be used, and how the components to be processed were to be secured and located in the holding fixtures for machining operations. Immediately plans were started to lay out and complete designs of suitable jigs and fixtures to support and accurately locate each component while in its various steps of fabricating. In passing, a jig is a special vise designed to hold work in process for drilling and reaming operations. A fixture is a special vise for holding work while in process of being milled or broached. A tool is any kind of cutting device used to remove metal or other material from a part in process.

"One of the first necessary steps before beginning the design of new equipment was to survey a very large quantity of machine-tool accessories on hand, previously used in other types of manufacture. At Springfield Armory there were great quantities of tools, jigs, and fixtures which had been used for years in the manufacture of the 1903 rifle and the manufacture of machine-gun parts, and those which had been placed in storage from war-time commercial plants. The necessity for this survey was to determine the suitability of the equipment on hand to adapt it to the manufacture of a new article for economical and time-saving reasons.

"The importance of these considerations will be understood when you understand that a weapon of the caliber .30, M1, type has some two thousand operations on its various components and that, in general, each operation requires a device to hold the work—either a jig or a fixture—a tool to cut the work, and a gage to measure the finished operation. There are therefore, in general, three items of accessory equipment which must exist for each operation: a jig or a fixture, a cutting tool, and one or more gages.

"It is seen, therefore, that to process an article of this type, there would be required some five or six thousand separate items of accessory equipment—each one of complicated and expensive design and each requiring many hours of design time and tool-room time for its completion. The magnitude of this undertaking may be brought home to anyone by the statement made by one of the largest and most experienced and best equipped tooling concerns in the country in consulting with Springfield Armory on this question. Their estimate was that they would require approximately twenty thousand hours of engineering study to plan this production and two hundred thousand hours of engineering and design time to prepare the tool equipment necessary to begin operation.

"WHILE the tool engineers were initiating designs of tools, jigs, and fixtures, the gage designers were beginning their studies of the necessary gage equipment. Gages are in a sense set apart from the other accessory equipment. In the first place, they must be extremely accurate. Consequently, they require very accurate design and workmanship—design and workmanship which must be performed by especially qualified men who comprise separate units both in the engineering section and in the tool room. Not infrequently there must be two gages for one operation, one to show the minimum dimension and one to show the maximum dimension.

"While the tool engineers were engaged on the foregoing undertaking, the equipment section of the engineering branch surveyed the machine tools on hand to determine their suitability for immediate use on a new production problem. Quite frequently they were found to be not suitable and new equipment was required. At Springfield Armory, all the machine-tool equipment on hand at the inception of manufacture of the M1 rifle had been installed at the armory for at least twenty years, much of it had been installed and in use for thirty years, and some of it antedated the Civil War. The great bulk of it was fitted with accessories designed to manufacture the Springfield rifle; the balance of it was fitted with miscellaneous tools and accessories designed for the manufacture of various machine-gun parts. It was a tremendous undertaking to survey this equipment and to determine whether it could be used in processing parts of the new article.

"An important consideration which entered into this study was that of modernizing our methods, adapting to them the many new processes of machining which had come into existence in the last twenty years—processes such as internal and surface broaching (formerly merely a theory and a hope), and coining instead of forging and machining for certain parts. By coining, I mean cold forming of shapes under tremendous pressures in dies similar to those used for hot forging. It was determined shortly that a great deal of new equipment was necessary and desirable.

"It then became necessary to select types of machines, to canvass the market and determine that these machines were available, to prepare specifications for them, to obtain money for their purchase, to advertise for them, to select suitable types from those proposed to be furnished, to make awards and await deliveries—a long-drawn-out and time-consuming procedure, often extremely unsatisfactory.

"THERE have been some differences in policy with respect to classes of machines heretofore regarded as standard machines and those classed as special machines. There has been some question of the advisability of tooling on so-called special equipment. Some years ago, before the tremendous impetus given the machine-tool industry by the production of automobiles, the term "standard machines" was considered to embrace milling machines, lathes of the plain and turrett types, profilers, drill presses, and automatic and hand screw machines. In the present day of high-production methods, broaches, multiple automatic drilling and boring machines, automatic profiling machines, and many other new types of equipment are produced in great quantities by many manufacturers and are considered fully standard. In fact, a production program not tooled on them is not abreast of the times.

"In this connection, there are some operations on the M1 rifle which have been referred to as impossible or very difficult. You may find it of interest to know that each of these operations was tooled by the designer of the gun, sometimes by the design of a special fixture, sometimes by the construction of a special machine. *In each instance these are the operations being produced at the highest rate and with the least difficulty.*

"While equipment was being selected and purchased, the engineering branch undertook to plan for the installation of equipment in a manner calculated to permit of economical flow of work from machine to machine and from shop to shop as regulated by the size of the orders impending and the necessity for keeping other work in process to sustain a reasonable working force. I refer to the necessity for having a component go into the first shop in which it was processed initially and then flow from there in a logical sequence from

operation to operation, with the least handling and the least delay, on to its final operation and thence to its point of final assembly. The difficulty of planning that particular phase of such an undertaking can readily be understood, especially when it was necessary to start with a small order and throw work into shops already occupied with other types of work, not necessarily flowing in a logical order.

"In planning production lines, the movement of machinery throughout a large plant becomes a colossal undertaking, especially when new arrangements have to be made while other current processing is kept in operation. I make particular reference to this type of procedure for Springfield Armory because the usual thing in starting a new production line is to shut down or have available a separate plant in which to place either old or new equipment, suitably arranged to provide for the proper sequence of operations for new production effort.

"In referring to tooling as a whole, the usual conception at Springfield Armory of how it should be accomplished has been that designs should be completed and accessory equipment fabricated in our own tool rooms. When you contemplate the number of hours of engineering and processing time necessary on accessory equipment, it will be realized what an extremely great length of time is necessary to complete all this work in one engineering section and one shop. Furthermore, the effort is confined within one group, resulting in the application of ideas and practices which perhaps have not kept pace with the most modern and best-known methods.

"The production of the M1 rifle began in a very modest way; it gained momentum surprisingly through unforeseen conditions and is now apparently well on its way toward a fairly comprehensive program. As a result of this, the War Department recently has obtained additional funds for increasing its production. Upon receipt of the directive to proceed with the additional program, the plan was formulated to call in the best-known tool engineers of the machine-tool manufacturers to have them study the problem of retooling and additional tooling on this article. The idea behind this not only was to expedite and decentralize the work of designing and manufacturing accessory equipment but also to obtain the very best advice and engineering effort in the country.

"In the early spring of 1938 this retooling effort was started by calling in tooling engineers from all the well-known organizations throughout the country, obtaining advice and inviting them to bid on lines of machine tools fully equipped and guaranteed to produce designated components at a definite rate. As preliminary ground work to this procedure, Springfield Armory reviewed each operation on each component of the rifle in conjunction with the best advice obtainable, rearranged the sequence, and reduced the number of operations, scheduling them to be performed in combinations and on the most modern high-production machinery. Parts to be completely processed and parts to be partially processed then were farmed out to commercial tooling concerns for the supply of completely equipped, ready-to-operate machine tools."

THERE is a similar outstanding example of production engineering in the case of the manufacture of artillery projectiles and cartridge cases at the Frankford Arsenal. A thoroughly modern production line for artillery ammunition is in operation at this arsenal. It includes the latest in machine tools and appliances. It has reduced the time factor of every operation materially. The table* on page 225 shows a production set-up based on six hundred and fifty 75-mm. shells per 8-hour day from forgings of conventional type with finished forged cavities which require no borings. Frankford Arsenal, prior to the installation of this modern arrangement using special machines, had been using older types of general-purpose machines. In the above-mentioned table, data on the modern production line appear in the left column and data on the obsolete line appear in the right.

It will be noted from these data that the application of modern production engineering principles and modern machine-tool equipment has effected these notable results: Manufacturing operations are reduced in number from 25 to 16; operators are reduced from 26.97 to 12.73. Here as never before the worth of production engineering is shown in its relation to the national defense—time of manufacture is cut drastically, production is increased, and on one item of equipment alone fourteen operators are released for some other useful national-defense effort.

AN equally illustrative example of the application of production engineering to the manufacture of artillery ammunition is the present practice at Frankford in the manufacture of brass cartridge cases. Here is heavy repetitive work. The twenty operations in the production of the 75-mm. field-gun cartridge case are shown in the table which appeared in "Cartridge Case Manufacture—More Production Engineering for Artillery Ammunition," by Brig. Gen. L. H. Campbell, Jr., which appeared in Army Ordnance, January-February 1940 (Vol. XX, No. 118, p. 240).

Each of the machines listed is of modern design. It is apparent that some of the best minds in industry and in the Army have been and are at work on this production-engineering problem. As another specific example of the utilization of modern practices in the production of Army ordnance, the light tank, M2A4, and the medium tank, M2A1, are excellent examples. Thirty-eight private manufacturers have been at work on these two vehicles.

Now our tanks are coming from the production lines with all the speed and uniformity of mass production. The technique of the automobile is now the technique of the tank. When one considers, then, that our production of these weapons includes (1) the professional military and civilian experience and skill applied in the Army, and especially in the Ordnance Department, to this question over many years; (2) the consultation and recommendation of such bodies as the Ordnance Advisory Committee of the Society of Automotive Engineers; (3) the assistance received from the leading producers whose names are listed here—when one considers these coöperative steps in production engineering, then it is obvious that production engineering holds a prominent place in the policies of the Ordnance Department.

Recently the Congress authorized a program of educational orders for training private industry in the technique of arms manufacture. These orders are filling their purpose splendidly; they are also a capital aid to production engineering because they permit added study of our designs and processes by more private producers. When such study shows that the Ordnance Department designs or processes can be

* "Artillery Ammunition," by Brig. Gen. L. H. Campbell, Jr.; *American Machinist*, May 17, 1940 (Vol. 83, No. 10, p. 328).

advantageously improved, the Department is quick to adopt the new and discard the old. The case of an educational order placed with the American Forge Company for forging 75-mm. shell is an excellent case in point.

There is also the case of the educational order placed with the Winchester Repeating Arms Company for the Garand mortar, submitted a most valuable report, the recommendations of which have been of great value in the production of that piece.

Finally, as a corollary to these steps in the progress to production engineering, the training of our officers to understand and appreciate the industrial viewpoint and modern

HIGH-EXPLOSIVE, 75-MM. SHELL, M48

*(Production is based on 650 shell per 8-hour day. Forgings: conventional type, finished, forged cavity.)*

MODERN PRODUCTION LINE BUILDING 55

| *Oper. No.* | *Operation* | *Type Machine* | *Machines* | *Operators* | *Weight ** |
|---|---|---|---|---|---|
| 1 | Face open end | W. & S. | 1.16 | 1.16 | 2,000 |
| 2 | Center | Foster | 0.65 | 0.65 | 1,400 |
| 3 | Rough face base | Frew | 1.40 | 0.70 | 2,500 |
| 4 | Turn for concentricity | Ex-Cell-O | 1.63 | 1.63 | 15,000 |
| 5 | Shot blast | Pangborn | 0.60 | 0.60 | 5,000 |
| 6 | Nose | Bliss crank press. | 0.50 | 0.50 | 12,000 |
| 7 | Rough face open end. | W. & S. | 1.00 | 1.00 | 1,000 |
| 8 | Finish turn | Ex-Cell-O | 1.00 | 1.00 | 7,500 |
| 9 | Drill and tap lock screw hole | 2-spindle drill press | 1.00 | 1.00 | 400 |
| 10 | Finish both ends and band seat | Bullard | 1.00 | 1.00 | 25,000 |
| 11 | Notch | Producto-Matic | 0.33 | 0.33 | 400 |
| 12 | Stamp | Noble & Westbrook | 0.33 | 0.33 | 400 |
| 13 | Knurl | Symington | 0.33 | 0.33 | 500 |
| 14 | Apply band | West tire setter. | 1.00 | 1.00 | 1,200 |
| 15 | Turn band | Sundstrand | 0.75 | 0.75 | 1,500 |
| 16 | Weld base cover | National | 0.75 | 0.75 | 2,500 |
| | | TOTAL | 13.43 | 12.73 | 78,300 |

ARTILLERY DEPT. FIGURES FOR PRODUCTION ON SYMINGTON MACHINES

| *Oper. No.* | *Operation* | *Type Machine* | *Machines* | *Operators* | Weight ** |
|---|---|---|---|---|---|
| 1 | Cut off open end | Symington | 3.00 | 1.50 | 3,000 |
| 2 | Center open end | 100# drop hammer | 0.13 | 0.13 | 7,000 |
| 3 | Center closed end | Symington | 0.65 | 0.65 | 1,000 |
| 4 | Rough turn | Symington | 5.38 | 2.69 | 6,000 |
| 5 | Rough face base | Symington | 2.25 | 1.13 | 3,000 |
| 6 | Shot blast | Gray | 0.60 | 0.60 | 5,000 |
| 7 | Nose | #69 Stoll press. | 0.50 | 0.50 | 12,000 |
| 8 | Chamfer open end | Symington | 0.33 | 0.33 | 1,000 |
| 9 | Center open end | 100# drop hammer | 0.13 | 0.13 | 7,000 |
| 10 | Finish turn (base to bourrelet) | Symington | 3.00 | 1.50 | 3,000 |
| 11 | Mark | Symington | 0.33 | 0.33 | 2,000 |
| 12 | Remove center boss | Symington | 1.20 | 1.20 | 2,000 |
| 13 | Weigh | Scale | 1.00 | 1.00 | 50 |
| 14 | Finish face base | Symington | 3.25 | 1.63 | 4,000 |
| 15 | Bore, face and undercut open end | Symington | 3.25 | 3.25 | 4,000 |
| 16 | Drill and tap lock screw hole | 2-spindle drill press | 1.00 | 1.00 | 400 |
| 17 | Tap open end | Symington | 1.30 | 1.30 | 2,000 |
| 18 | Form nose | Symington | 2.00 | 2.00 | 2,000 |
| 19 | Band seat | Symington | 1.62 | 1.62 | 2,000 |
| 20 | Knurl | Symington | 0.33 | 0.33 | 500 |
| 21 | Grind bourrelet | Symington | 1.30 | 1.30 | 3,000 |
| 22 | Press band | West tire setter. | 1.00 | 1.00 | 1,200 |
| 23 | Mill notch | Symington | 0.33 | 0.33 | 400 |
| 24 | Turn band | Symington | 0.77 | 0.77 | 1,000 |
| 25 | Weld base cover | National | 0.75 | 0.75 | 2,500 |
| | | TOTAL | 35.40 | 26.97 | 75,050 |

*Weight includes motors and all equipment.
**Weight of machine exclusive of line and countershafting, motors, etc. Add weight of motors, shafting, etc., for production of 650 shell per day on Symington machines (15,000 lbs.).
Floor space required for Symington set-up (650 shell per day) exclusive of inspection, washing, painting and packing: 2,600 sq. ft.
Floor space required for modern set-up (650 shell per day) exclusive of inspection, washing, painting and packing: 1,376 sq. ft.

semiautomatic rifle. The company having installed a modern production line of limited capacity was in a position later to bid on a production order for the rifle. Not only had new techniques been developed through the educational order but the processes were somewhat simplified by the private producer who applied to the work all the experience and skill of production engineers who had been engaged in the production of small arms with distinction for many years. During the past year, ninety-two ordnance educational orders have been placed.

The Ordnance Department during the past year also has placed a number of production studies with companies which are allocated for war-time manufacture of ordnance. These studies are placed under contract. They are really production-engineering studies for they permit the manufacturer to analyze production of the allocated item from the standpoint of his facilities and equipment and to suggest changes which would increase production rates. During the past six months, seventy-five contracts for ordnance production studies covering ninety-four various items of ordnance equipment have been placed.

Two other aids to production engineering in the Ordnance Department should be cited. The Department is in constant consultation with engineering and professional societies in order that the services of these groups may be utilized. The American Society of Mechanical Engineers, through a special committee to study the production engineering of the 80-mm. methods must not be overlooked. Not only do our officers gain practical shop experience by service at the arsenals and in private plants, but our schooling system aims to develop in them an attitude of utilizing the best features of business and industry for prompt and economical production of the arms, ammunition and implements of war needed by the fighting forces of the United States Army.

FROM this narrative it should be clear that the Ordnance Department, so far as production engineering is concerned, has followed two commendable lines of endeavor. The first of these is the utilization of commercial skills and facilities, both for machines and actual production of armament. The second is the cultivation of and insistence upon production-mindedness. By following the former course, the Department is availing itself of the engineering skills of American industry. By stimulating the latter, the Department is making certain that the trends of modern engineering and industry in the field of mass production shall be woven into the very fiber of its organization and practice. The rule is: the weapons, that is to say, the *ordnance,* with which the American Army is to be equipped must incorporate the latest and best practices of production engineering. In the observance of this rule lies the greatest assurance that in an emergency the priceless ingredient—time—will be saved. The policy of the Ordnance Department is to observe the rule to the best of its ability.

# Armament Production, II

*HERE are listed the names of the principal companies which have coöperated with the Ordnance Department in the design and production engineering of the various types of ordnance matériel and components thereof in connection with the military armament program begun in 1939. Opposite each name is the item on which the coöperative endeavor has been especially helpful to the Department. This list was compiled from data collected by Brig. Gen. G. M. Barnes with the assistance of the several divisions of the Ordnance Office, the collaboration of the six manufacturing arsenals and the field-service depots throughout the United States and the possessions. This listing is indicative only and therefore is not necessarily complete.*

| *Facility* | *Item* |
|---|---|
| Achorn Steel Co. | Armor plate |
| Air Reduction Sales Corporation | Armor plate |
| Ajax Electrothermic Corporation | Heat-treating methods for armor-piercing projectiles |
| Allegheny Ludlum Steel Co. | Armor plate |
| Allegheny Metal Co. | Metallurgy |
| Allis-Chalmers Manufacturing Co. | Tank transmission; hydraulic tractor controls |
| Alox Corporation | Rust-preventive |
| Aluminum Company of America | Aluminum alloys; transmission cases; gun carriages; metallurgy |
| American Brass Co. | Metallurgy; cartridge cases |
| American Car & Foundry Co. | Light tanks; bomb bodies; special railway cars |
| American Chain & Cable Co. | Armor-piercing bullets |
| American Gas Furnace Co. | Heat treating |
| American LaFrance and Foamite Corporation | Fire extinguishers |
| American Manganese Bronze Co. | Metallurgy |
| American Powder Mills | Black powder |
| American Steel & Wire Co. | Rolled plate; heat-treating equipment |
| American Steel Foundries | Armor plate |
| American Tool Works | Combination lathes |
| Ampco Metals Co. | Metallurgy |
| Arcos Corporation | Welding |
| Arkell Safety Bag Co. | Charge caps |
| Armstrong Blum Co. | Hacksaw |
| Atwood Vacuum Co. | Tow connection |
| Austin-Western Road Machinery Co. | Prime mover |
| Babcock & Wilcox Co. | Refractories and insulating materials |
| Bakelite Corporation | Lacquer |
| Baldwin Locomotive Co. | Tanks |
| Barnes Drill Co. | Honing machines |
| Bausch & Lomb Optical Co.; | Gaging data; range and height finders |
| Bay State Tool & Machine Co. | Rifle and machine-gun parts |
| Beacon Oil Co. | Armor plate |
| Bendix Aviation Corporation | Time fuze; data transmission system; electrical equipment |
| Bendix-Westinghouse Automotive Air Brake Co. | Air brakes |
| Beryllium Corporation of Pennsylvania | Barrel steels |
| Bethlehem Steel Co. | Die forgings; armor-piercing shot; metallurgy |
| Boston Consolidated Gas Co. | Heating, cutting, and welding apparatus |
| Edgar Brandt Co. of France | Trench mortars |
| Breeze Corporations | Radio shielding; starters; armor plate; automatic gun controls |
| Briggs Clarifier Co. | Oil filters |
| Briston Scientific Instrument Co. | Recording control processes |
| Browne & Sharpe Manufacturing Co. | Tools and cutters |
| Buda Co. | Scout car and engines |
| Budd Wheel Co. | Wheel hubs |
| Buick Motor Co. | Tank engine |
| Bullard Co. | Machines |
| Burgess Battery Co. | Acoustic studies; mufflers |
| Byrd Expedition | Tank testing |
| Campbell Wyant & Cannon Co. | Shell steel |
| Carboloy Co. | Metallurgy |
| Carborundum Co. | Honing |
| Carnegie-Illinois Steel Co. | Armor plate; gun tubes; gun barrels |
| Carpenter Container Co., Inc. | Containers |
| Carpenter Steel Co. | Armor-piercing shot and bullet cores; barrel steels |
| Caterpillar Tractor Co. | Tractors |
| Chase Brass Co. | Metallurgy |
| Chemical Radium Co. | Radiography |
| Chrysler Corporation | Medium tanks; small-arms bullets; metallurgy |
| Cincinnati Milling Machine Co. | Machine tools |
| Cleveland Tractor Co. | Prime mover; controlled differential |
| Cleveland Twist Drill Co. | Metallurgy |
| Climax Molybdenum Co. | Bullet cores |
| Colt's Patent Fire Arms Mfg. Co. | Automatic weapons; chromium plating |
| Consolidated Machine Tool Co. | Boring mills |
| Consolidated Steel Corporation | Bomb bodies |
| Container Co. | Containers |
| Continental Motors Corporation | Tank engine |
| Corning Glass Co. | Bullet-resisting glass |
| Corning-Illinois Fiberglas Co. | Flare parachutes |
| Crucible Steel Co. | Bullet cores; chromium plating; special steels; metallurgy |
| Dearborn Chemical Co. | Rust preventive |
| Del-Ray Machine Co. | Machines |
| Delta Oil Co. | Rust preventive |
| Diebold Safe & Lock Co. | Armor plate |
| Disston & Sons, Inc., Henry | Armor plate; armor-piercing shot |

| *Facility* | *Item* |
|---|---|
| Donaldson Co., Inc. | Air cleaners |
| Dow Chemical Co. | Magnesium alloy |
| Du Gas Co. | Fire extinguishers |
| Du Pont de Nemours & Co., E. I. | Bullet-resisting glass; cellulose; synthetic rubber; FNH propellent powder; high explosives; lacquers; measuring instruments; pyrotechnic parachutes; small-arms propellants |
| Eastman Kodak Co. | Radiography |
| Edgewater Steel Co. | Die forgings |
| Electric Wheel Co. | Special trailers |
| Empire Electric Brake Co. | Electric brakes |
| Ex-Cell-O Corporation | Broaching machines |
| Finkle & Sons, A. | Metallurgy |
| Firestone Tire & Rubber Co. | Bullet-sealing tubes; high-speed tires; rubber-block track |
| Fleming Manufacturing Co. | Oil filters |
| French & Hecht Co. | Wheels |
| Fulgent Co., N. J. | Flares |
| Fuller Brush Co. | Gun bore brushes |
| Garlock Packing Co. | Artillery; artillery recuperator packing |
| General Electric Co. | Cartridge cases; tank transmission; gun stabilizer; armor plate |
| General Motors Corporation | Fluid flywheel transmission; tank engine |
| General Railway Signal Corporation | Cast-iron shell |
| General Specialties Corporation | Gun stocks |
| General Steel Castings Co. | Cast armor plate |
| Giddings & Lewis Machine Co. | Boring mills |
| Gilbert & Barker Co. | Circulating pumps |
| Giroux Industries | Pyrotechnic parachutes |
| Gisholt Machine Co. | Machine tools; turret lathes |
| Goodrich Co., B. F. | Bullet-sealing tubes; continuous-band track; rubber-block track |
| Goodyear Tire & Rubber Co. | Bullet-sealing tubes; tires; rubber-block track |
| Greenfield Tap & Die Co. | Tools and gages |
| Guiberson Diesel Engine Co. | Tank engine |
| Hampden Brass Co. | Nonferrous alloy |
| Handy & Harman Co. | Silver brazine alloys |
| Hardy, Inc., Charles | Metallurgy |
| Harris Calorific Co. | Heating, cutting, and welding apparatus |
| Harvard University | Engineering counsel |
| Hayes Gas Furnace Co. | Heat-treating processes |
| Haynes Stellite Corporation | Bullet cores |
| Heatbath Corporation | Finishing processes |
| Hercules Motor Co. | Scout-car engine |
| Hercules Powder Co. | Propellants; measuring instruments |
| Holden Heat Treating Co. | Heat-treating processes |
| Houghton Co., E. F. | Cutting lubricants; packings |
| Hyatt Roller Bearing Co. | Antifriction bearings |
| Hyde, George J. | Submachine gun |
| Hydraulic Controls, Inc. | Hydraulic controls for tractors |
| Hydraulic Press Manufacturing Co. | Straightening presses |
| Industrial Gas Engineering Co. | Design of recirculating furnaces |
| International Nickel Co. | Cast armor plate; cast plate; metallurgy |
| Johnson Automatics Trust | Light machine gun |
| Jones & Lampson Co. | Special gaging machines |
| Kellogg Co., M. W. | Armor plate |
| Keuffel & Esser Co. | Range and height finders |
| Kidde & Co., Walter | Fire extinguishers |
| Kilgore Manufacturing Co. | Pyrotechnics |
| King Powder Co. | Black powder |
| Koppers Co. | Metallurgy |
| Krebs Pigment Co. | Lacquer development |
| Lapointe Machine Tool Co. | Broaching machinery |
| Lebanon Steel Foundries | Cast armor plate |
| Le Blonde Co., R. K. | Gap lathes |
| Leeds & Northrup Co. | Laboratory equipment; recording control processes; temperature-measuring device |
| Le Fere Forge & Machine Co. | Special shell body |
| Libbey-Owens Ford Co. | Bullet-resisting glass |
| Lincoln Electric Co. | Welding procedures |
| Linn Manufacturing Co. | Prime mover |
| Mack Truck Co. | Field dynamometer |
| Magna-Flux Co. | Metal examination |
| Magor Car Corporation | Wheel trucks and couplers |
| Mallory Co., P. R. | Barrel steels |
| Marmon-Herrington Co. | Prime mover |
| Martin-Parry Corporation | Artillery adapter |
| Martin Co., L. | High explosives |
| Massachusetts Institute of Technology | Engineering counsel |
| Maxson Corporation | Fire-control mechanisms |
| Metal & Thermit Corporation | Welding procedures |
| Metropolitan Engineering Co. | Mortar projectile |
| Micrometric Honing Co. | Honing equipment |
| Midvale Steel Co. | Metallurgical Counsel |
| Milwaukee Machine Co. | Machine tools |
| Minneapolis-Moline Co. | Prime mover |
| Moore Drop Forge Co. | Forging dies |
| Motors Improvements Co. | Oil and fuel filters |
| Murray Manufacturing Co. | Bomb bodies |
| National Forge & Ordnance Co. | Metallurgy |
| National Tube Co. | Bomb bodies; gun tubes |
| National Valve & Manufacturing Co. | Bomb bodies |
| Never-Oil Bearing Co. | Metallurgy |
| New England Gas Co. | Armor plate |
| New Jersey Zinc Co. | Metallurgy |
| Niles Tool Works | Gun lathes |
| Norton Co. | Grinders; honing recuperator cylinders |
| Park Drop Forge Co. | Die forgings |
| Parker Rustproofing Co. | Finishing processes |
| Philips Petroleum Co. | Armor plate |
| Pioneer Instrument Co. | Compasses |
| Pittsburgh Piping & Equipment Co. | Bomb bodies |
| Pittsburgh Plate Glass Co. | Bullet-resisting glass |
| Pratt Industries | Mufflers |

| *Facility* | *Item* |
|---|---|
| Pratt & Whitney | Drills and reamers; machine tools; gaging equipment |
| Rathbone Co., A. B. & J. | Forming |
| Remington Arms Co. | Breech mechanism; noncorrosive primers |
| Republic Steel Corporation | Cartridge cases; metallurgy |
| Rockwell Co., Stanley P. | Metal testing |
| Rustless Iron & Steel Co. | Barrel steels |
| Saginaw Stamping & Tool Co. | Bomb trailer |
| Scovill Manufacturing Co. | Metallurgy |
| Seiberling Rubber Co. | Bullet-sealing tubes |
| Seneca Falls Lathe Co. | Special lathes |
| Seneca Falls Machine Tool Co. | Gun lathes |
| Sherwin-Williams Paint Co. | Lacquer development |
| Simonds Saw and Steel Co. | Armor plate |
| SKF Industries | Antifriction bearings |
| Smith & Wesson Co. | Submachine gun |
| Souther Engineering Co., Henry | Metallurgy |
| Sperry Gyroscope Co. | Fire-control mechanisms; automotive test equipment; compasses; gun stabilizer |
| Spicer Manufacturing Co. | Power train |
| Spiral Brushes, Inc. | Gun bore brushes |
| Standard Oil Co. of Indiana | Recoil-mechanism oil |
| Standard Oil Co. of New Jersey | Lubricating oils; recoil-mechanism oil |
| Standard Oil Development Co. | Synthetic toluol |
| Standard Products Co. | Rotating-band protector |
| Super Steel Castings Co. | Armor castings |
| Synthane Corporation | Cartridge cases |
| Thompson Gibb Electric Co. | Welding machines |
| Timken-Detroit Axle Co. | Bogie and limber system; transmission |
| Timken Roller Bearing Co. | Antifriction bearings; gun tubes; alloy steels; barrel steels |
| Titanium Alloy Manufacturing Co. | Metallurgy |
| Titeflex Metal Hose Co. | Radio shielding |
| Trojan Powder Co. | TNT |
| Tucker Manufacturing Co. | Power drive |
| Una Welding, Inc. | Welding procedures |
| United Engineering Foundry Co. | Welding equipment |
| U. S. Motors Corporation | Generating equipment |
| U. S. Rubber Co. | Bullet-sealing tubes; rubber-block track |
| Universal Boring Machine Tool Co. | Boring mills |
| Vacuum Oil Co. | Lubricating oils |
| Vanadium Alloy Steel Corporation | Metallurgy |
| Van Dorn Iron Works | Armor plate |
| Vickers Co. | Power drive |
| Vortox Manufacturing Co. | Air cleaners for tanks |
| Waber Co. | Bullet-sealing tubes |
| Wallace Barnes Co. | Spring-making machines |
| Waltham Horological Mfg. Co. | Mechanical time fuze |
| Walton & Lonsbury | Chromium plating |
| Warner Electric Brake Co. | Electric brakes |
| Warner & Swasey Co. | Machine tools |
| Waterbury Tool Co. | Centrifugal casting equipment; design of gymnasicator; hydraulic speed gears |
| Wehr Steel Co. | Armor plate |
| Weiden Hoff, Inc., Joseph | Automotive testing equipment |
| Wellman Co., S. K. | Clutch and brake lining |
| Westinghouse Electric & Manufacturing Co. | Black light for night lighting; bomb bodies; fuze regulator; gun stabilizer |
| White Motor Co. | Half-track car; scout cars |
| Whitney Nichols | Machine tools |
| Wilcox-Rich Co. | Metallurgy |
| Winchester Repeating Arms Co. | Antitank cartridge; incendiary bullets; noncorrosive primers; semiautomatic rifle |
| Wine Railway Appliance Co. | Volute springs |
| Wisconsin Axle Co. | Low tunnel for combat vehicles; transmissions |
| Wright Aëronautical Corporation | Tank engine |
| Youngstown Sheet & Tube Co. | Metallurgy |

## Proceedings of the Twenty-First Annual Meeting

*THE Twenty-First Annual Meeting of the Army Ordnance Association was held at the Waldorf-Astoria, New York City, on Tuesday, October 8, 1940. Fifteen hundred and fifty-four guests attended the annual dinner. The program, which extended throughout the day, included a technical and engineering session, an industrial-mobilization luncheon, an industrial-preparedness round table and the annual dinner. The complete proceedings, to be published in full in the next issue of* ARMY ORDNANCE, *will include the addresses of the following speakers: Hon. William S. Knudsen, Chief, Production Division, National Defense Advisory Commission; Hon. Robert P. Patterson, the Assistant Secretary of War; Hon. Lewis Compton, Assistant Secretary of the Navy; Maj. Gen. C. M. Wesson, Chief of Ordnance, U. S. Army; Maj. Gen. James H. Burns, Executive Assistant to the Assistant Secretary of War; Brig. Gen. R. H. Somers, Chief of the Technical Staff, Office of the Chief of Ordnance; Brig. Gen. Burton O. Lewis, Special Assistant for Production, Industrial Service, Office of the Chief of Ordnance; Brig. Gen. G. M. Barnes, Special Assistant for Engineering, Industrial Service, Office of the Chief of Ordnance; Brig. Gen. L. H. Campbell, Jr., Special Assistant for Plant Facilities, Industrial Service, Office of the Chief of Ordnance; Col. H. H. Zornig, Aberdeen Proving Ground; Lieut. Col. J. K. Christmas, Aberdeen Proving Ground. The next issue of* ARMY ORDNANCE *will be mailed December 26, 1940.*

# Speeding the Armorer's Task

THE modern armorer differs from his ancient counterpart only in this: modern invention has multiplied his speed and modern methods have trebled the power of his handiwork. Another way of saying the same thing would be that as science and industry, labor and management, have increased the tempo and the comforts of modern peace, so have the same forces quickened the movement and intensified the power of modern war.

In conjunction with the foregoing study of Ordnance engineering policies, the following pages of pictures are published to give the reader some idea of the use of modern practices in the arsenals and private plants now at work on the military armament program. These establishments are on a three 8-hour shift basis, six days a week.

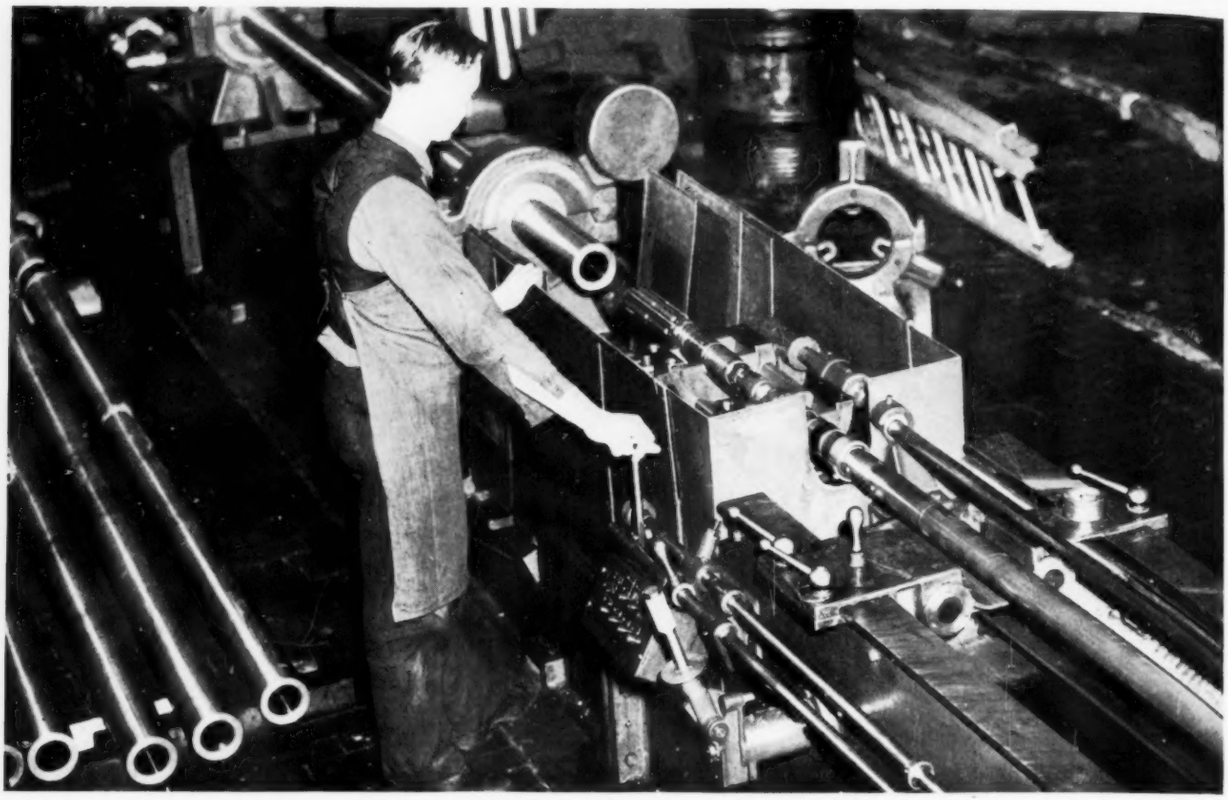
Policy in this regard was announced recently by the Assistant Secretary of War, Hon. Robert P. Patterson. "Our arsenals," said Mr. Patterson, "are primarily laboratories and small-scale producers. If worked to their fullest capacity, our Ordnance arsenals, for instance, could produce but ten per cent of our armament needs. The rest must come from industry; but the tooling up of industry for our present needs is one of our serious bottlenecks. Consequently, it is of the greatest importance that the arsenals, which possess the equipment and training for the production of some of the most difficult items, be used to their fullest capacity. Under the recent authority granted by the Congress, the Secretary of War has placed arsenal workers on a 48-hour week. As a result, the production of the new Garand rifle, ammunition, antiaircraft and seacoast guns has been considerably increased." (The 48-hour week started August 10.)

*Acme*

The six Ordnance manufacturing arsenals of the U. S. Army are Watervliet, Picatinny, Watertown, Frankford, Rock Island, and the Springfield Armory. Watervliet Arsenal, at Watervliet, N. Y., is the Army's gun factory for the manufacture of artillery weapons, from the smallest field howitzers up to 16-inch seacoast guns. Picatinny Arsenal, at Dover, N. J., is devoted to the manufacture of propellent powder and the loading of artillery ammunition. Springfield Armory, at Springfield, Mass., has been manufacturing small arms for the U. S. Army since 1795. The Model 1903 rifle and the caliber .30 M1 rifle—the Garand semi-automatic—were both developed at Springfield. Throughout the years, the armory has contributed greatly to the progress of interchangeable manufacture which finally has become one of the outstanding characteristics of the American system of mass production. Watertown Arsenal, Watertown, Mass., was established in 1816 and is engaged in the manufacture of gun forgings and centrifugal castings, railway, seacoast, and anti-aircraft artillery. At the Frankford Arsenal, Philadelphia, Pa., small-arms ammunition, artillery shells, and fire-control instruments for all classes of artillery are produced. Rock Island Arsenal, at Rock Island, Ill., was begun in 1862. It is engaged in the manufacture of mobile artillery, gun mounts, and tanks.

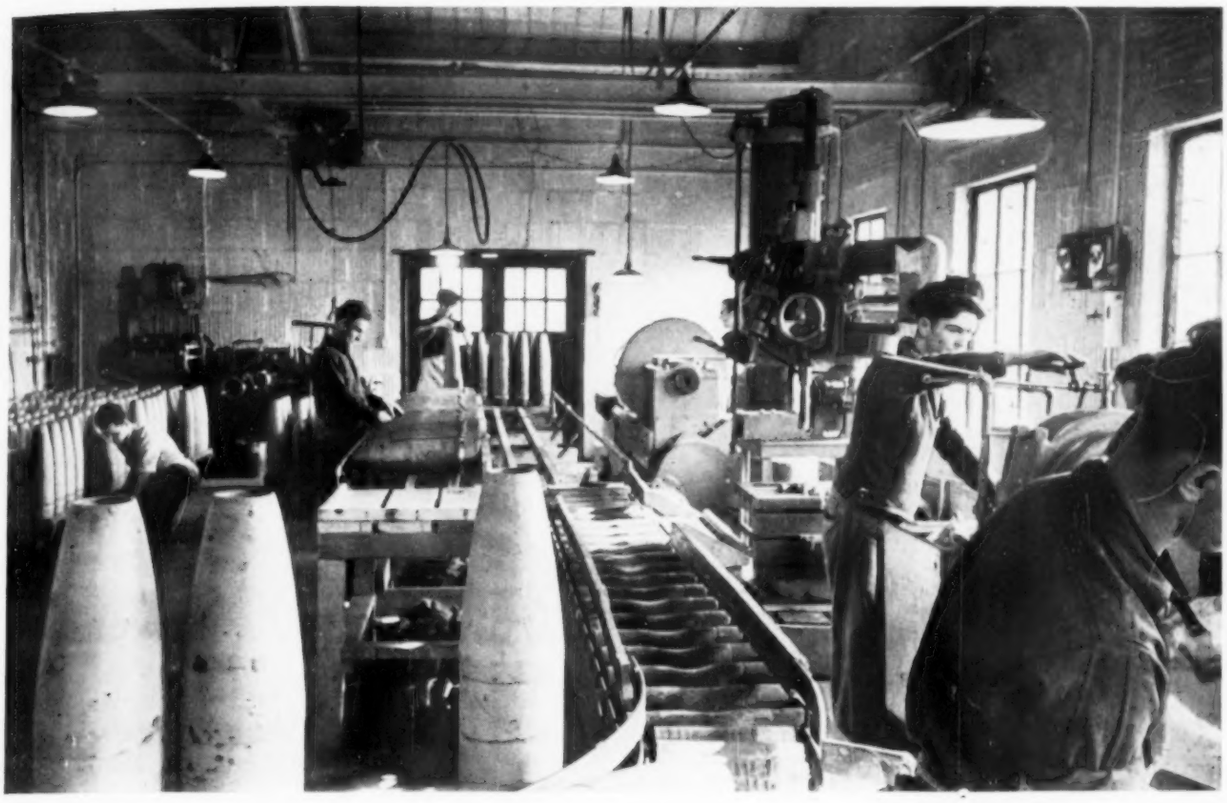
It is important to remember always that these arsenals can produce but a small part of the Army's needed equipment. Private industry must supply the rest. The American Car & Foundry Company, now producing (see page 236) light tanks for the Army, is one of many splendid examples of industrial coöperation with the military armament program.

# Watervliet Arsenal

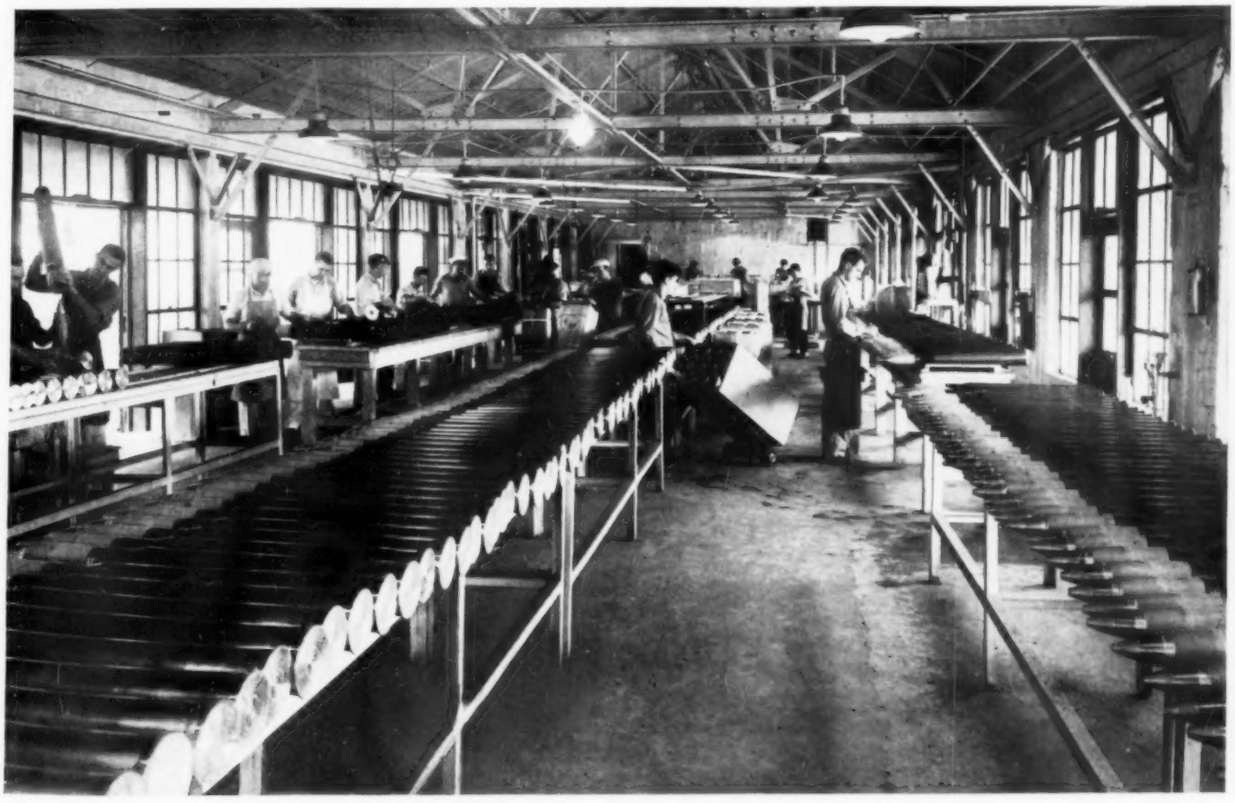


*Watervliet Arsenal, located at Watervliet, N. Y., is the Army's principal gun manufacturing plant and the chief source of its cannon of larger caliber. The illustration above shows a honing operation on a 3-inch antiaircraft gun. Below, the big guns are shown in position on the turning machines (International photo). A year is needed to complete one of these weapons.*

# Picatinny Arsenal

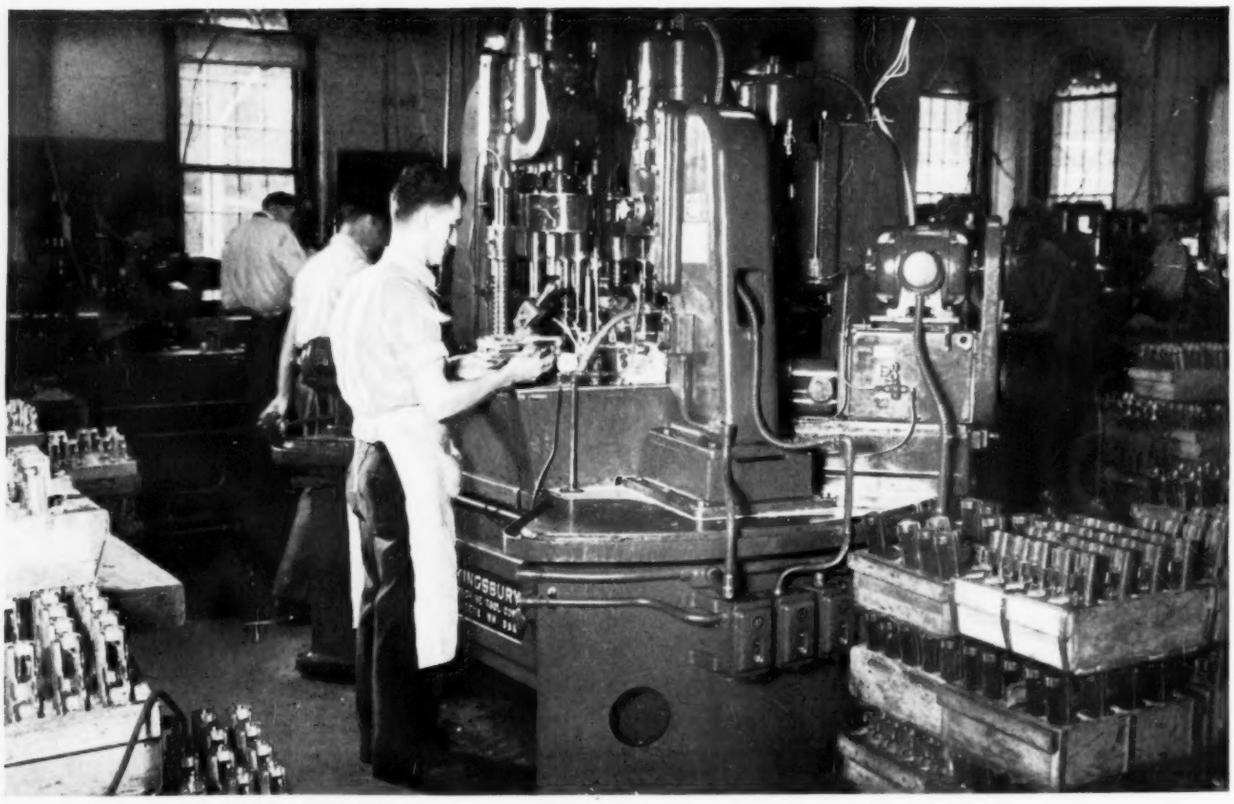


*Picatinny Arsenal, Dover, N. J., originally was designated as a storage depot for powder. Projectile sheds, nitrate buildings and a loading plant later were erected, followed by the construction and equipment of a powder factory. In the photograph above, large-caliber shells are being renovated after storage, while below, complete rounds are being loaded and packed.*

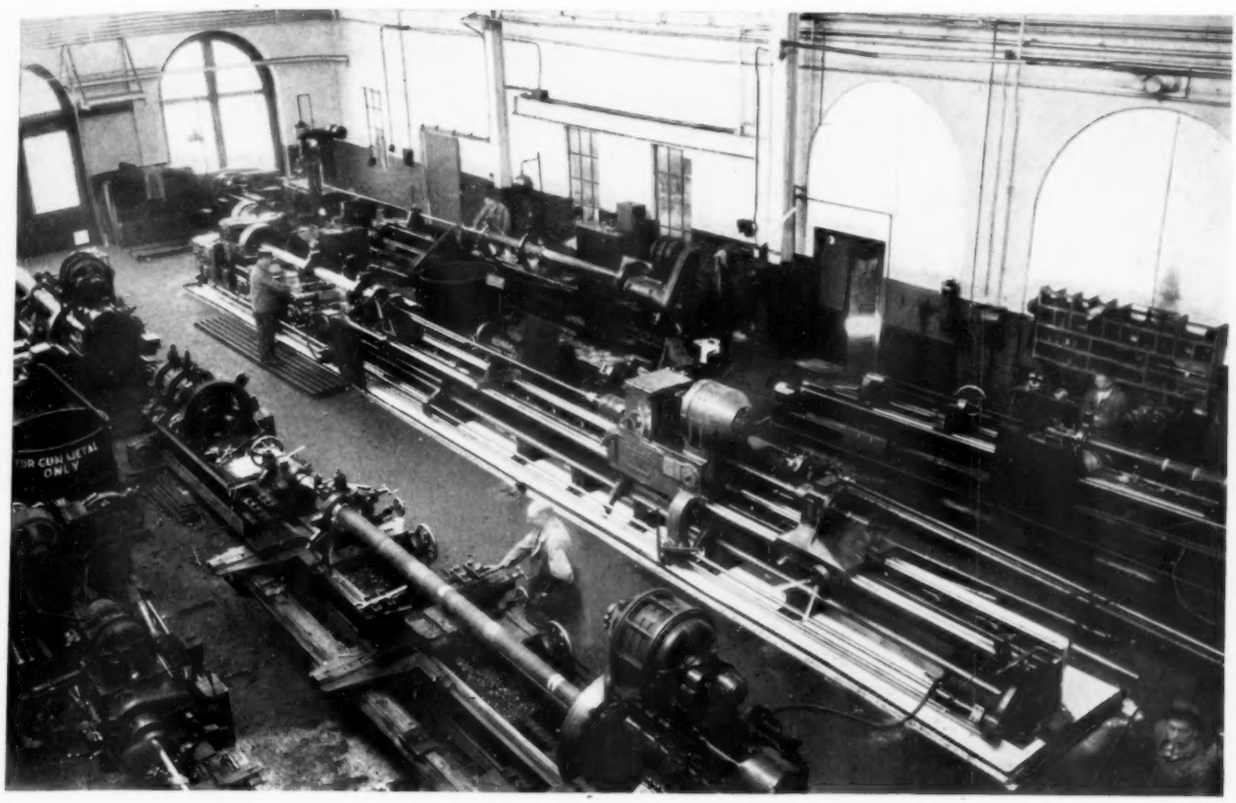


# Springfield Armory

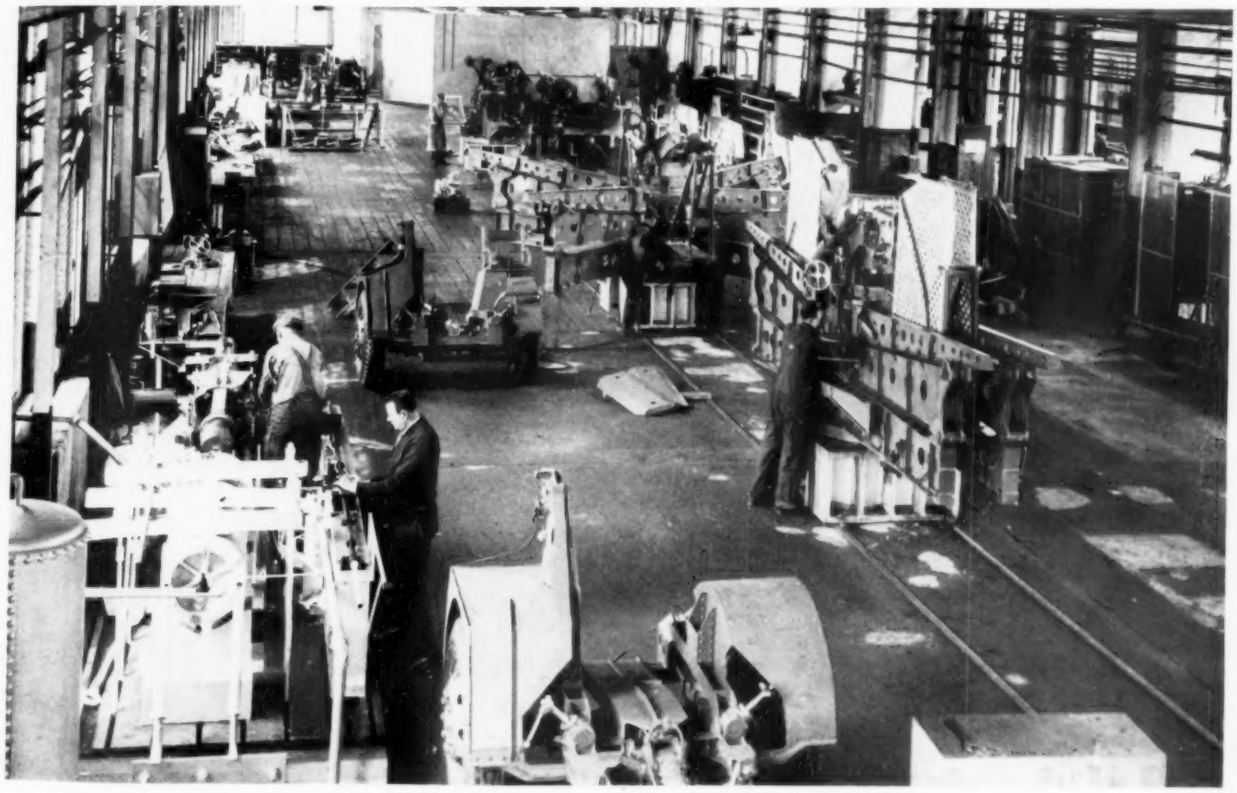
*Springfield Armory, Springfield, Mass., is devoted to the manufacture of small arms for the fighting forces of the United States. Now thoroughly modernized, Springfield is the oldest U. S. Army arsenal. The illustration above shows the trigger-housing line for the new caliber .30, M1, semiautomatic rifle; below, is an operation on the receiver of the same weapon.*



# Watertown Arsenal



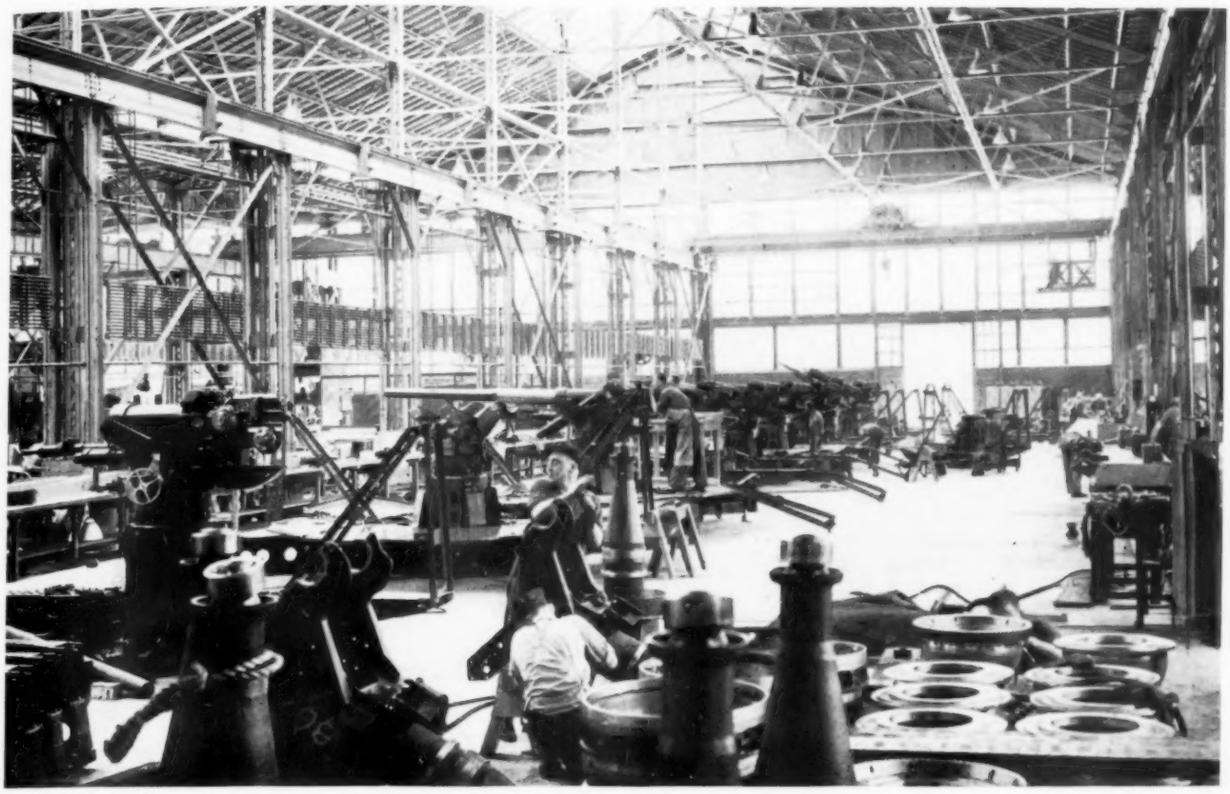
*Watertown Arsenal, Watertown, Mass., metallurgical center of weapon development, is engaged in the manufacture of gun forgings and centrifugal castings, railway, seacoast, and antiaircraft artillery. Gun-turning and boring lathes are shown in action above on the production of gun barrels. Below is the assembly line for 3-inch antiaircraft gun carriages.*



## Frankford Arsenal

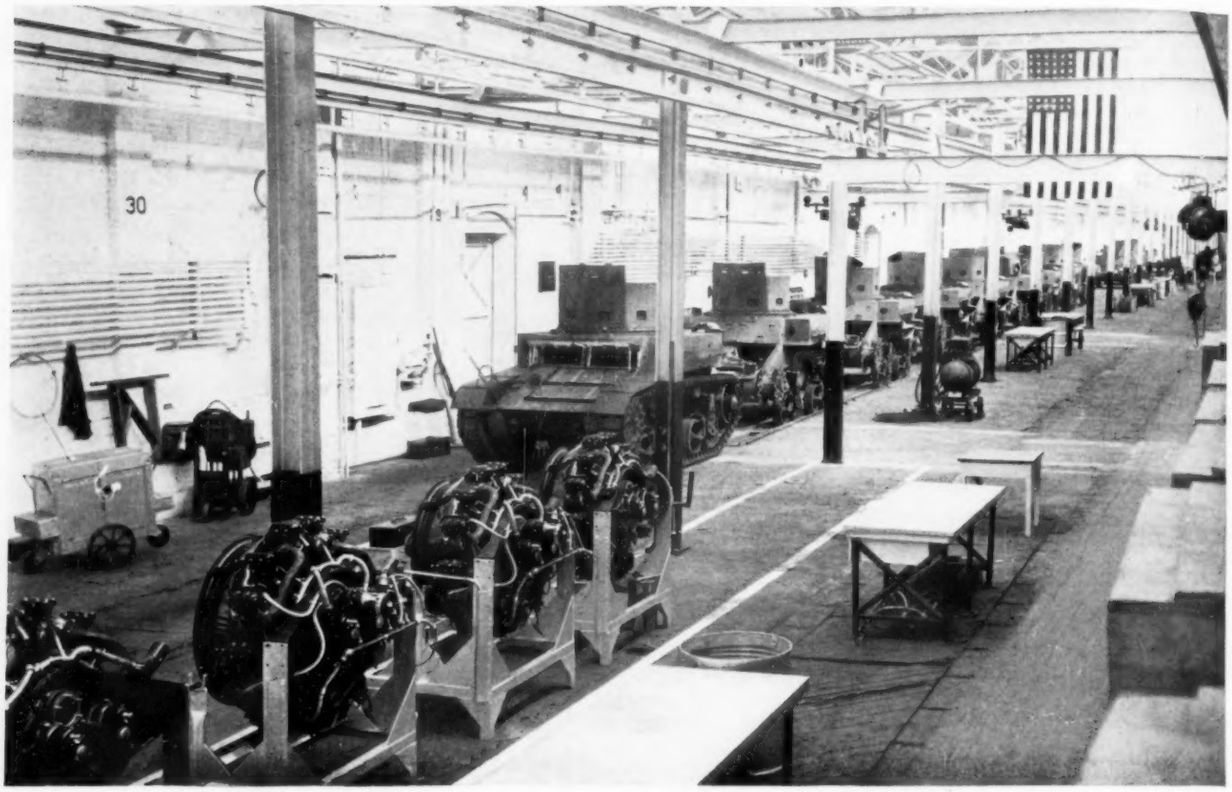
*Frankford Arsenal, Philadelphia, Pa., is engaged principally in the manufacture of optical instruments, small-arms and artillery ammunition. The illustration above shows a line of drilling machines for mechanical time-fuze plates. The photograph below shows girls at work recessing, drilling and tapping caps for later assembly into complete fuzes.*

# Rock Island Arsenal



*Rock Island Arsenal, Rock Island, Ill., is the Army center for the manufacture of mobile artillery, gun mounts, tanks and other automotive equipment, machine guns and their mounts. The photograph above shows a production line for 3-inch antiaircraft gun mounts. Below is shown a similar line for the production of caliber .50 antiaircraft machine-gun mounts.*

## American Car & Foundry Company




*The American Car & Foundry Company is producing large quantities of the new light tank for the Army at its Berwick, Pa., plant. Here, for the first time, tanks are shown on a commercial production line. Part of the line is shown above, with the tanks ready for the installation of their radial engines. A close-up view of the new light combat vehicle is shown below.*

# Air Warfare and the Cities

## The Increasing Trend to Unlimited Combat

By Lieut. Col. A. M. Prentiss*

IN the two decades since the World War, volumes have been written by military authors of all degrees of competence in efforts to arrive at a definite concept of the scope and character of the "next war." These prognostications have varied all the way from the lurid headlines of the sensational press to the closely reasoned estimates of military experts who have sought to evaluate the new weapons, especially airplanes, tanks, and gas, in terms of the classical principles of war.

Out of this world-wide welter of discussion there gradually have emerged two principal schools of thought. The conservative school holds that, despite the far-reaching and enormously destructive power of modern weapons, decisions in war still will be reached upon the battlefield and that in the future, as in the past, the only way to defeat an enemy will be to overcome his armed forces in the field.

On the other hand, the radical school of thought contends that since the ultimate object of war is to impose one's will upon an enemy, the primary aim of armed conflict is to destroy the resistance of its people and thus break its will to war. This can be accomplished, it is asserted, by bringing such pressure on a nation's civil population that public opinion will compel the government to sue for peace. In the past, such pressure has been applied most effectively through the defeat of an enemy's armed forces. Now, however, the vast range and destructive power of modern bombardment aviation affords ready and adequate means of subduing an enemy by enabling one nation to apply an overwhelming pressure directly to its opponent's civil population.

The new doctrine of direct air action against the civil population was first formulated by the Italian general, Giulio Douhet, and published in 1921 in a book entitled "Air Supremacy." The main points of his thesis may be stated as follows: "In war on land, the power of the defense is far greater than that of the attack, and therefore victory can only be secured by the employment of vastly superior military forces. On the other hand, in the case of air attack, the power of the offensive is immeasurably greater than that of the defensive, since it is practically impossible to prevent a determined air attack from being pushed home, owing to the difficulty of finding and intercepting hostile bombers before they reach their objective. Because of the inherent impossibility of effective defense against it, air attack, without military or naval support, can compel a hostile state to surrender. This being the case, it follows that the air force must be regarded as the primary arm of national defense."

While Douhet wrote from the viewpoint of his own country, his arguments were founded upon such a logical basis they immediately attracted a great deal of attention in foreign countries and have undoubtedly played an important rôle in the development of air policy among the world powers.

One of the immediate effects of the Douhet air-power doctrine was the critical examination and reorientation of national-defense establishments in all the principal countries of the world, with the general result of vastly increasing the air armaments of each country. In the United States, the Douhet doctrine was attacked vigorously by the conservative military school and as warmly defended by the radical air-power school. The conflict of views of these schools is well illustrated by the evidence given before the President's Aircraft Board (commonly called the "Morrow Board") which was assembled at Washington in 1925 to consider the question of the proper organization of the United States Air Service.

IN the hearings of the Morrow Board, the radical air-force viewpoint was expressed by the late Brig. Gen. William Mitchell, U. S. Army, who served as Assistant Chief of Air Service in charge of operations and technical development, from 1921 to 1924. He is reported to have said:

"Air power holds out the hope to the nations that, in the future, air battles taking place miles away from the frontiers will be so decisive and of such far-reaching effect that the nation losing them will be willing to capitulate without resorting to a further contest on land or water, on account of the degree of destruction which would be sustained by the country subjected to unrestricted air attack . . . To gain a lasting victory in war, the hostile nation's power to make war must be destroyed—this means the manufactories, the means of communication, the food products, even the farms, the fuel and oil, and the places where people live and carry on their daily lives. Not only must those places be rendered incapable of supplying the armed forces, but the people's desire to renew the combat at a later date must be discouraged. Aircraft operating in the heart of an enemy's country will accomplish this object in an incredibly short space of time, once the control of the air has been obtained, and the months and even years of contest of ground armies, with loss of millions of lives, will be eliminated in the future."

The conservative military view is reported to have been expressed by Maj. Gen. Charles P. Summerall, U. S. Army, who commanded our Fifth Corps in the World War and was later Chief of Staff of the Army, as follows:

"We hear much said about enemies bombing our cities. I do not understand that in war it is in accordance with the laws or rules of war to bomb cities or areas occupied by noncombatants. My impression of the fortification of our harbors was that they were fortified, not to keep our cities from being shelled by an enemy's fleet, but to keep our harbors from being occupied by an enemy's fleet and transports, thus making them a base for operations against our citizens. I do not believe that we are preparing to bomb enemy cities occupied by noncombatants and defenseless people. As far as we are concerned, in war the only object is the enemy's army . . . I do not believe that civilized war in which we may be engaged is going to attack undefended cities and kill women and children. If our enemy does that, while it will be sad for us, it will bring about his defeat all the quicker, because the

*Chemical officer, Sixth Corps Area, Chicago, Ill. Lieutenant Colonel, Chemical Warfare Service, U. S. Army.

world will not tolerate that kind of thing . . . The objective has always been and always will be the enemy's army. If that falls, everything falls."

The testimony quoted above shows the wide divergence in the viewpoints of the best-informed minds concerning the conduct of modern war and the rôle of air power therein which obtained at that time (1925) not only in this country but generally among the principal world powers.

During the fifteen years that have elapsed since the deliberations of the Morrow Board, aviation, both civil and military, has developed at such an astounding rate that it has transcended even the most sanguine predictions of its ardent advocates. The most serious aspect of this phenomenal development is the enormous increase in range, speed, and carrying capacity of bombardment airplanes for, in the last analysis, the air menace is the menace of the bomber.

The best bombers used in the World War had a speed of approximately 100 miles an hour, a useful carrying capacity of 500 kilograms (1,100 pounds) and an effective radius of action of about 350 miles. Today, bombardment airplanes carry bomb loads up to 6,000 pounds, fly at a speed of approximately 300 miles an hour, and have an effective radius of action of at least 1,000 miles.

VIEWING with alarm the rapid growth of aviation in the early years following the World War and foreseeing its almost unlimited potential power of destruction unless restricted by some form of international agreement, the principal world powers have made repeated but abortive efforts to arrive at some form of international agreement which would prevent unrestricted air warfare and particularly the bombardment of the civil populations of belligerent states.

Before considering the postwar efforts to regulate air warfare by international agreement, it seems desirable to glance briefly at the situation regarding bombardment of cities generally, as it existed before and during the World War. Up until 1899, the traditional rule, under the "custom of war," was that a fortified city was subject to bombardment, while an unfortified city was not. In 1899, the first Hague Conference adopted the view that immunity of a city from bombardment depended entirely upon whether or not it was defended. Up to that time, the sole means of bombardment envisaged was by artillery fire.

Between 1899 and 1907 the increasing use of balloons in warfare caused the second Hague Conference of 1907 to insert in the prohibition of bombardment the phrase "by any means whatever" so as to place air bombardment in the same category with artillery fire. However, with respect to bombardment by naval forces, the 1906 convention introduced a new doctrine. While still forbidding the bombardment of undefended towns, it permitted a naval force to bombard "military works, military or naval establishments, depots of arms or war material, workshops or plant which could be utilized for the needs of the hostile fleet or army." Here we see introduced for the first time the principles of the "military objective" and the "separability of the target." The naval commander now could fire into an undefended port, under certain conditions, and if he used due care to avoid unnecessary damage to other places, he incurred no responsibility for any unavoidable damage under such circumstances.

During the World War, there was great divergence in practice with respect to air bombardment and little or no unity of viewpoint regarding rules of air warfare generally. In theory at least, the principle of the military objective seems to have been rather widely accepted, and the prevailing practice, as asserted on both sides, was to bomb only objectives of military importance wherever situated, with due care to avoid unnecessary damage to nonmilitary life and property.

While the actual results of air bombardments in the World War deviated widely from the principle of the military objective, this doctrine was predominant in all discussions of air bombing during the war, each belligerent insisting that he strictly observed the rule, while his opponents violated it. The situation was complicated still further by the introduction of a new criterion on the legitimacy of air bombardment; namely, the principle of retaliation or reprisal, and every air bombing operation which clearly violated the principle of the military objective was justified on the grounds of reprisal for some alleged prior violation of the rule by the other side. Such was the situation concerning air warfare at the end of the World War.

THE first postwar effort to restrict air combat by international agreement was made by a commission of jurists sitting at The Hague in 1923. This commission drafted a comprehensive code of rules for the regulation of air warfare. Of these rules the following articles are sufficiently pertinent to be quoted in full:

"Article 22.—Aërial bombardment for the purpose of terrorizing the civilian population, of destroying or damaging private property not of military character, or of injuring noncombatants is prohibited. . . .

"Article 24.—1. Aërial bombardment is legitimate only when directed at a military objective; that is to say, an object of which the destruction or injury would constitute a distinct military advantage to the belligerent.

"2. Such bombardment is legitimate only when directed exclusively at the following objectives: military forces; military works; military establishments or depots; factories constituting important and well-known centers engaged in the manufacture of arms, ammunition or distinctively military supplies; lines of communication or transportation used for military purposes.

"3. The bombardment of cities, towns, villages, dwellings or buildings not in the immediate neighborhood of the operations of land forces is prohibited. In cases where the objectives specified in paragraph 2 are so situated that they cannot be bombarded without the indiscriminate bombardment of the civilian population, the aircraft must abstain from bombardment.

"4. In the immediate neighborhood of the operations of land forces, the bombardment of cities, towns, villages, dwellings or buildings is legitimate provided that there exists a reasonable presumption that the military concentration is sufficiently important to justify such bombardment, having regard to the danger thus caused to the civilian population."

It will be noted that article 24 declares that aërial bombardment is legitimate only when directed at a *military* objective and that bombardment of such objectives is legitimate only when it is directed "exclusively" against them. Furthermore, the only *persons* who may be bombarded are "military forces." This apparently would not include civilian munitions workers, although there would seem to be no reason why they should be entitled to the immunities of noncombatants, when they are in effect almost the same as men engaged in the supply and auxiliary services of the army. However, since

munitions factories and other establishments in which they work may be bombed, their immunity covers them only while they are at home. While it may be argued that when in their homes, munitions workers are in no way different from the ordinary population, the same may be said of purely military personnel, so that it may be doubted whether the distinction is sound.

It will be noted further that the criterion set up in article 24 is whether the object to be bombed is one whose destruction or injury would constitute a "distinct military advantage" to the attacking belligerent. While this is a reasonable and sound rule that has been approved widely by those who have studied the matter carefully, it has the defect of any rule which seeks to restrict aërial bombardment to specified objects which are situated in urban communities and are immediately surrounded by other objects and persons which it is forbidden to bomb. The inherent difficulty is that aviators cannot possibly confine their bombs "exclusively" to such objects.

Thus it is obvious that an aviator flying at night at a great height over a darkened city cannot with certainty identify objects and persons he is permitted to bomb. As Professor James A. Garner says: "How can he distinguish between the military forces and the civil population; between military works, depots, and factories engaged in the manufacture of arms and munitions or used for military purposes, and other establishments engaged in the manufacture or production of articles used for civil purposes; or between railway lines used for military purposes and those which are not? To require aviators to single out one class of persons and things from the other and to confine their attacks 'exclusively' to *one* of them will in many cases be tantamount to an absolute prohibition of all bombardment" ("Proposed Rules for the Regulation of Aërial Warfare," in the *American Journal of International Law*, 1924, p. 69).

It was largely on account of such obvious and inherent difficulties as these that The Hague Air Warfare Rules of 1923 were not ratified, even by the participating countries.

A SECOND effort to restrict air warfare by international agreement was made at the Geneva Disarmament Conference of 1932-1934. The principal proposals discussed at this conference were the following: (1) Abolition of all air bombardment, except for police purposes in certain outlying regions; (2) Complete abolition of military and naval aircraft and effective supervision of civil aviation to prevent its misuse for military purposes; (3) The pooling of all bombardment aircraft under an international authority for the purpose of preventing aggression; (4) Restriction of bombardment aircraft to certain permissible types.

The common weakness of all these schemes is that they require some form of international supervision and control to make them really effective, and an unscrupulous state may, by secret measures, completely circumvent the restrictions and thus gain a tremendous material advantage in a war with another state which has conscientiously abided by the rules. For these and other reasons, the efforts of the Geneva Disarmament Conference came to nothing, failing with the failure of the conference as a whole.

The latest proposal for limiting air bombardment by international agreement was the resolution adopted by League of Nations Assembly, September 30, 1938, which recognizes the following principles as a necessary basis for any subsequent regulations: (1) The intentional bombing of civilian populations is illegal; (2) Objectives aimed at from the air must be legitimate military objectives and must be identifiable; (3) Any attack on legitimate military objectives must be carried out in such a way that civilian populations in the neighborhood are not bombed through negligence.

It is doubtful if this latest proposal will be any more successful in practical results than its predecessors, since the same inherent difficulties remain. The term "military objective" still is practically impossible to define adequately, and it is equally impossible to determine whether a bombardment of the civil population was intentional, negligent, or unavoidably incident to the bombing of legitimate military objectives. All in all, it is hard to see how the future security of civilization is to be obtained by the regulation of air warfare through international agreement.

THE means of defense against air attack usually are grouped in two general categories: active and passive. The active means of defense comprise the following instrumentalities in their approximate order of relative importance: interceptor and pursuit aviation, bombardment aviation, attack and support aviation, antiaircraft artillery and machine guns, balloon barrages, searchlights (auxiliary to pursuit and antiaircraft defense).

The passive means of air defense are designed to minimize the possible effects of air attack and usually embrace the following measures, in their approximate order of relative importance:

1. Prevention of panic among the civil population by prior organization, training, and equipment.
2. Means for warning personnel of the approach of hostile aircraft to insure that all persons in a threatened area are prepared when the attack is delivered (air warning service).
3. Provision of air-raid shelters for the protection of personnel against bombardment.
4. Protection of individuals against gas, by educating them with regard to its powers and limitations, by equipping them with gas masks and protective clothing, by training them in first aid for gas casualties, and by providing an organization for this purpose.
5. Maintenance of vital public utilities and services (water, food, transport, communications, etc.), by material protection where practicable, and by providing an organization for emergency services, repairs, etc.
6. Protection of important buildings and structures and prevention or localization of damage caused by high-explosive and incendiary bombs.
7. Medical treatment of casualties, including an organization for their collection, hospitalization, and evacuation.
8. Means for effecting blackouts of vital areas and restricting essential lights at night.
9. Evacuation of nonessential personnel from the more important vital areas.

The outer ring of the *active* air defense consists of the interceptor and pursuit airplanes, generally termed fighters, whose mission it is to contact the approaching bombers and try to prevent them from reaching their objective.

Fighting aircraft are characterized by their small size (they usually are one-seaters), high speed, maneuverability, great climbing power and relatively short cruising range. They generally are equipped with multiple machine guns and are supposed to have the advantage over the bombing airplanes

by reason of their greater speed and maneuverability. In recent years, however, the speed of bombers has been increased so markedly that the defensive fighters no longer enjoy their former margin of speed. Also, with bombers flying at 300 miles an hour and the fighters at speeds up to 400 miles an hour, it has become increasingly difficult to secure effective hits with machine guns, so that the task of the fighter is much more difficult than formerly. For this reason, some of the most recent fighting airplanes are being equipped with light rapid-fire cannon.

Modern bombers can fly at altitudes of 30,000 feet or more and are then completely invisible from the ground, even in broad daylight. On clear days, aircraft are practically invisible from the ground when flying above 18,000 feet, and the altitude at which they may be seen from the ground steadily decreases with adverse visibility conditions. On foggy or misty days, bombers can approach a hostile area at extremely low altitudes, for they are concealed from both air and ground observation and can easily reach their objectives by blind (instrument) flying. On cloudy days, bombers can travel with comparative safety at the cloud ceiling by taking advantage of the clouds for concealment and emerging only momentarily for orientation on their course or objective. On dark nights it is extremely difficult for fighting aircraft to find hostile bombers, even if the weather is clear, and especially is this true when the bombers are flying above the range of ground searchlights, which seldom exceeds 15,000 feet under the most favorable conditions.

Another recent development which materially aids the bombers to elude hostile fighters is the so-called "technique of silent approach" first employed during the recent Spanish Civil War. John Langdon-Davies, writing of the attacks on Barcelona ("Air Raids," London, 1938), states that the bombers rose to a great height, shut off their engines many miles out at sea, and glided down toward their objective so that they could not be detected by listening posts. They then dropped their bombs, still undetected by the enemy, and actually were on their way home when the bombs fell on the target. He further states that in 1918 the best gliding angle was about 1 to 20, and that since then great progress has been made, so that now a medium-weight bomber might glide at 120 miles an hour at an angle of 1 to 30. At this rate, a loss in altitude of only 5,000 feet would permit an airplane to approach its objective silently from a point 30 miles away.

Even if the defensive fighters succeed in locating and closing with hostile bombers, it by no means follows that they will succeed in preventing them from reaching the target area because of the rugged all-metal construction and heavy armament of modern bombing airplanes. The bomber of today has little to fear against the hostile fighter plane.

IF the defensive interceptor and pursuit air forces fail to prevent hostile bombers from reaching the target area, the next active means of defense is the antiaircraft artillery. While antiaircraft guns have been improved greatly in range and accuracy since the World War, the difficulty of hitting hostile bombers also has enormously increased by reason of their greater speed and flying altitude, so that the advantage appears still to reside on the side of attacking aircraft. The advantage of the airplanes is still further increased by concealment during their approach and the surprise with which they can deliver their attacks.

It is obvious that no matter how great the efficiency of antiaircraft artillery fire, hostile bombing planes cannot be put out of action unless they are discovered in time for artillery to register upon them, are visible during the time the guns are firing, and are within range of the guns. All the concealment factors that have been mentioned as favoring the bomber against the fighter apply with the same force against antiaircraft fire.

Another form of air attack which is particularly effective against ground targets is the low-flying (hedgehopping) attack from fast, light bombers or attack airplanes *(Stukas)*. These planes may rendezvous at a high altitude out of sight of their objective, gain very high ground speeds by power diving, and then fly over the objective at extremely low altitudes, seldom exceeding a few hundred feet. They generally are concealed during their approach to the objective by masking features of the terrain, which are taken advantage of for concealment during the approach flight.

Large-caliber antiaircraft guns are not adapted for firing on fast-moving airplanes at altitudes below about 3,000 feet; the only form of antiaircraft fire that can be brought to bear against this type of attack is that from small rapid-fire cannon (*e.g.*, 37-mm.) and large-caliber machine guns. For protection against this type of fire, the attacking airplanes are equipped to lay down blanketing smoke screens which blind the antiaircraft guns and conceal the planes during their flight over the target area. While these smoke blankets also cut off the view of the target from the attackers, precision methods of bombing are not necessary at these low altitudes, and bombs may be dropped with effectiveness by orienting on prominent terrain features visible to the airplanes above the smoke blanket.

Perhaps the most effective form of defense against low-flying attack airplanes is the balloon barrage. It was employed to some extent during the latter part of the World War and have since been somewhat increased in altitude and effectiveness. However, they have very marked limitations in the protection of large areas from air attack. To be effective up to the height employed, they must be placed in one or more continuous rings and spaced very close together; *i.e.*, about one hundred yards apart. Hence, to inclose a target area of any considerable size, such as a large city, an almost prohibitive number of balloons with a corresponding number of winches and personnel to man them are required. But the chief limitation of the balloon barrage is its relative low effective altitude.

The only remaining means of active defense against air attack which holds out definite promise of effectiveness is to destroy the enemy bombers at their airdromes. This is the mission of defensive bombardment aviation. There is no doubt but that it is easier to destroy enemy airplanes on the ground than in the air. Moreover, airdromes in the open are very vulnerable to air attack and when so damaged will greatly hamper the enemy's air activities. However, counter measures such as underground bombproof shelters for airplanes, camouflaged and widely dispersed auxiliary operating fields, and heavy antiaircraft defense of airdromes will render air attacks on such largely nugatory.

In addition to the various means of active defense against air attack outlined above, there appears to be but one other remedy against hostile air aggression; namely, direct air action against the enemy's industrial economy and civil population.

This measure undoubtedly has two effects of military

value. It requires the enemy to keep a large portion of his air force at home on the defensive in an attempt to prevent or minimize such attacks, and it hampers his munitions production in the bombed areas. But perhaps the greatest power of air attack on the enemy's home territory resides not in its direct military effect, but rather in its potential restraining effect upon the enemy when threatened as a reprisal measure. When confronted by a hostile power having a strong bombardment air force, no state will initiate bombardment of the enemy's civilian communities without careful consideration of the possible results of reprisal bombings of its own population. Thus the greatest defensive value of bombardment aviation can well be its potential threat rather than its actual use against noncombatants.

AN examination of the passive means of air defense at once reveals that they cannot guarantee a nation against hostile air attacks but can considerably mitigate their severity against the civil population and lessen material damage to vital public and private property. If fully developed, passive defensive means also can make hostile air attack against the civil communities of a nation largely unprofitable from a military point of view. This is particularly true if the passive defense of the nation attacked is sufficient to prevent a breakdown of the morale of its civil population.

It is not generally realized what enormous quantities of bombs and extensive military effort are required to damage large communities seriously. When this effort is diverted from purely military objectives, it necessarily greatly weakens the aggressive power of the state engaging in such tactics; hence, the only justification for such direct air action against a civil population is the assurance that it will have such a devastating moral effect as to cause the population to compel its government to sue for peace. Any effect, short of this result, is more than questionable, for it is apt to bring about in a determined enemy population an even greater hostility and will to continue the war to a successful conclusion at all costs.

In future wars, air power is destined to play a constantly increasing rôle. The development of bombardment aviation already has reached a point where its range and destructive power make it one of the major means of waging war. Air power may be used to supplement military and naval forces by striking directly at armies in the field and fleets in action, or by operating against the enemy's munitions industry and economic system generally with a view to undermining the foundations of his military strength. Air power also may be used to destroy the morale of a hostile state by bringing such pressure directly against the civil population that public opinion will compel the government to sue for peace.

Despite the great improvement in interceptor and pursuit aviation and in antiaircraft artillery since the World War, the development of bombardment aviation has been even more remarkable, so that today the advantage in warfare still appears to lie with the attacking bombers. This is particularly true when the factors of surprise and concealment in bombing operations are considered.

Since bombers now can reach their objectives by instrument flying in almost any kind of weather, they may conceal their approach under the cover of darkness, fog, mist, clouds, or by artificial smoke. By the new technique of silent approach, they cannot be detected by sound locators. Bombers also can fly above and below the effective ranges of antiaircraft guns. As neither defensive air forces nor antiaircraft artillery can engage bombers unless they can see them, it is obvious that the bombers, by concealing their approach, may carry out surprise attacks without much hindrance from antiaircraft defense.

Competent military authorities generally seem agreed that no amount of air defense, active or passive, can prevent a determined enemy from pushing home widespread and devastating air attacks on the territory of an enemy state if the aggressor has a sufficiently powerful air force and is willing to accept the losses that a well-organized defense can inflict. It by no means follows, however, that direct air action against an enemy's civil communities will, in itself, be sufficient to win a war, as asserted by General Douhet and the radical school of air thought. The great weight of opinion still insists that wars cannot be won by air action alone, but must be accompanied by victory on land and sea, as in the past. This conclusion seems amply borne out by the results of recent conflicts in Europe and the Far East.

IF air power is employed as the primary arm in war, its best chance of success, when acting alone, would appear to be against the enemy's civil population in the large cities. To succeed in such a war, the aggressor state must have a vast superiority in air power; it must be able to mobilize an air force sufficient to strike an overwhelming blow against its opponent's civil population and vital nerve centers; it must attack suddenly and without warning so as to take its enemy by surprise before he can prepare his civil population to resist the devastating effects of large-scale air attacks on the cities, and it must wage unrestricted and ruthless warfare without regard to international custom and precedent. If all these conditions are fulfilled, it appears to be within the realm of possibility that air power alone might be able to win a war. Lacking any of these conditions, it seems equally clear that air power alone cannot overcome a first-class state.

But, regardless of whether air power is used alone or in conjunction with military and naval forces, it is almost inevitable that the great cities will be targets for air attack. And it seems equally clear that the civil population in these cities will suffer from these attacks, since it is practically impossible to destroy industrial establishments and other legitimate military objectives located in the cities without great injury to the surrounding population.

Since international agreements have proved powerless to cope with air warfare and since no amount of air defense can prevent a prepared and determined enemy from pushing home large-scale air attacks on cities, if he is willing to accept the losses inflicted by the defense, the importance of passive measures of protection has become increasingly apparent.

With respect to the cities, perhaps one of the best answers to the menace of air attack is to make such attack *militarily unprofitable*. This can be achieved by thoroughly preparing the population to resist air bombardments by organization, training, and equipment, by evacuation of nonessential personnel from large urban communities, and, last but not least, by the removal of munitions factories, public utilities, and vital manufacturing establishments from the cities into the country. If these steps are taken, the cities no longer will present strategically worth-while targets, and the only effect of bombing them will be to terrorize the civil population. If the people are prepared for this form of warfare, it will not be worth the enormous expenditure of ammunition required.

# Break-Through Tanks

## Will They Bring Freedom of Action to Armored Divisions?

By Capt. C. R. Kutz*

IN the year 1940, after only six weeks of fighting, the Army of France—"greatest in Europe"—laid down its arms. The $500,000,000 Maginot Line, the "Little" Maginot Line—its lesser extension—and the Belgian fortresses not only failed to stop the German armored might, but they did not even materially slow it down. The press has been full of charges and countercharges, recriminations and *the* reason for the fall of France. But the French defeat did not come from any single internal failure nor from any new and secret weapon developed by the German high command. It was rather the sum of a great number of reasons, each apparently insignificant in itself but *in toto* utterly disastrous.

One weapon used by the Germans, the heavy break-through tank, came as a surprise to many—military men as well as civilians. Judging by the comment of the news correspondents it might be assumed that the break-through tank was the German Army's much-discussed "secret weapon." But the heavy tank is far from new. It received its first great test in smashing a highly organized defensive position in the Battle of Cambrai in 1917. It was the tremendous success of the break-through tank in the World War that caused German General von Zwehl to say: "It was not the genius of Marshal Foch that defeated us, but General Tank."

The postwar armies of Europe paid scant attention to the technical development of the heavy tank, its tactics and technique, and the difficult problems of strategic movement. Here and there a few pilot models were built but never in sufficient quantity to exert a decisive influence in such an action as the Battle of Flanders. Only Cermany, through the influence of the writings of Gen. Ludwig Ritter von Eimannsberger ("Mechanized War") realized that break-through tanks were as essential to modern war as armored divisions and attack aviation.

The other nations of Europe, wishing to avoid the tremendous cost of heavy tanks, deluded themselves into the belief that swarms of tankettes, working in close support of infantry, and armored forces for distant action would keep warfare in the open and prevent a repetition of the 1914-1918 stalemate. Surprisingly enough, these theories were propounded during the era in which France built her Maginot Line, Belgium rebuilt the defenses of Liége and Namur, Baron Mannerheim constructed a wall of forts across Finland's southern frontier, Czechoslovakia set up her never-used Sudetenland forts, and Germany trained military engineers by erecting the Siegfried Line along the Rhine. In the past year, Rumania constructed a unique barrier to prevent Russia from doing what she did—take over Bessarabia. During the peace years, much more was written on how strong these fortifications were than on how to penetrate them and give armored forces scope for action.

The German Army illustrated one method when she took Czechoslovakia's defenses via the appeasement route and then proceeded with typical efficiency to use them as a vast training ground for the combat team of break-through tanks, assault infantry and engineers, and attack aviation. Russia gave to the world the first combat example of how not to crack a modern defensive position. Failing in her efforts to flank the Mannerheim Line, Russia assaulted first with thin-skinned medium tanks, then with artillery and massed men. The latter succeeded but only after paying an appalling price in blood. Then on May 10, 1940, German break-through tanks, estimated to weigh seventy tons, armed with 77-mm. or 155-mm. cannon and flame throwers, opened up a hole in the Little Maginot Line. Through this gap poured, not the cavalry the British planned to use at Cambrai in 1917 nor a handful of armored cars that exploited the gap at Amiens in 1918, but massed armored divisions closely backed by infantry in trucks. The age of mechanization came into its own.

The American Army has a brand-new Armored Corps, but as yet it has no modern heavy tanks. The closest thing to them are the one hundred Mark VIII tanks that have been out of service for nearly a decade. Pending the development and production of modern machines, the Mark VIII tanks could be used for training crews and testing new design features. But immediately the question arises: Why does America need a break-through tank? Neither Mexico nor Canada have Maginot Lines waiting to be smashed. Since there are no highly organized defensive positions in the Western Hemisphere, where would these tanks be used? While American policy does not contemplate a European or Asiatic expeditionary force, few would be rash enough to predict the temper of the American people a year from now or the changed conditions of a rapidly changing world. If this country is invaded it must be prepared to stabilize a defensive position, repel hostile break-through tanks, and ultimately shatter the invader's defenses and drive him from our shores. This article, however, is an attempt to analyze the tactics of the break-through tank and discuss its major design features.

THE history of armored warfare reveals the fact that the heavy break-through tank has two definitely established battle missions. Its first mission, as its name implies, is to smash a hole in any well-organized defensive position, thus allowing the light armored divisions to strike a decisive blow at vital rear areas. The second mission of the break-through tank, and one that is equally important, is to deliver an effective counterattack against the most formidable hostile break-through tank that might be brought against us. (The chart on page 244 illustrates briefly the characteristics of the principal types of heavy break-through tanks built during and after the World War.)

Maj. Fritz Heigl, the noted Austrian authority, states in "Taschenbuch der Tanks": "The heavy tanks of World War development uniformly showed the demand for maximum spanning ability, good agility, and high vertical climb resulting from the shell-torn and trench-covered terrain of the Western Front." The development since the World War of special antitank barriers, traps, portable mines, special en-

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tanglements, concrete pillboxes, and gun bunkers demands the same characteristics. The more recent development of 20-mm., 37-mm., and 47-mm. antitank guns and the use of 75-mm. fieldpieces for defense against tanks make heavy armor imperative. Modern heavy tanks have greatly increased armor protection. The best will protect against some hits from a 75-mm. weapon.

The fire power of a break-through tank must be based on the combat purpose of the machine. For assaulting well-prepared defenses, two or more guns of 75-mm. caliber seem sufficient. To counterattack heavily armored break-through tanks, an armament of one gun of 105-mm. or 155-mm. caliber is required. In addition, machine guns are needed to provide close-in protection for the tank and to take care of hostile infantry caught in the open. An antiaircraft gun also must be provided. The modern trend has been to mount the cannon in revolving turrets and the machine guns in the hull as well as the turrets. Sponsons, so highly thought of by the early British designers, have been largely discarded. One reason for this was the development of sprung suspension systems. Another was the lowering of the height to which the track was lifted. While this expedient increased speed, it also reduced the height of a vertical object that the tank could surmount. Possibly the deciding factor against sponson mounts was that the field of fire was limited and the sponson had to be swung inboard for rail travel. To provide the maximum fire power, an arrangement which combined the features of the British Mark V Star and the French Char 3-C would be ideal. A modern break-through tank would then have a 155-mm. gun in the forward turret, a 75-mm. in the rear turret, and two 75-mm. guns in sponsons.

The idea of using flame throwers in tanks originated in 1918 when the United States Corps of Engineers produced a pilot model of a steam-propelled 50-ton tank. This tank mounted a flame thrower and four machine guns. Steam was chosen as the motive power in order to utilize a 700-pound pressure steam jet to discharge the flame. Later this was changed and a separate gasoline engine operating a pressure pump was installed. The maximum range was thirty yards where a ball of flame some twenty feet in diameter was developed. The purpose of the flame thrower was to neutralize concrete pillboxes that could not be crushed.

Since the World War, Italy has experimented with flame throwers in light tanks, but it remained for Germany to adopt the American idea and use it to the utmost. Recent battle reports indicate that the German flame throwers, used principally to neutralize the gun bunkers of the Maginot Line, have a range of nearly 100 yards and develop a thermal heat of 2,000 degrees. Their effect upon morale is tremendous. A small percentage of break-through tanks should be provided with flame throwers of modern design. The 75-mm. guns in the sponsons could be replaced by fuel-storage tanks and necessary auxiliary machinery.

BATTLEFIELD mobility is of course basic in the design of a heavy tank. Of no less importance is the vital problem of moving break-through tanks from one theater of operations to another. Visionaries who propose monster tanks weighing hundreds or even thousands of tons seldom tell how such vehicles are to be moved from place to place. It is apparent that the low speed of break-through tanks, the relatively short life of their tracks, and lack of highway bridges of sufficient capacity combine to make long-distance road travel out of the question. The only other practical means available is rail travel.

The fact that rail travel is imperative makes it possible to set the maximum outside dimensions of the break-through tank. A careful study of railroad data pertaining to clearances of tunnels over 1,000 feet in length indicates that on the major railways of the United States, Canada, and Mexico the limits would be 10 feet, 4 inches (width) and 14 feet, 5 inches (height). This figure is the maximum height above the rails. Allowance must be made for the flatcar or special carrier. The maximum length due to curves would be the same as that of the longest standard railway car—usually about seventy feet. Allowing 3 tons per foot for a tank with 3 inches of armor, a 70-foot tank would weigh 210 tons. While this weight does not exceed that of some of the larger locomotives, the sphere of action of the tank would be limited by the capacity of the bridges over which it could pass.

The heavy tanks of World War days, with the exception of the German K tank, could be moved on most standard flatcars. To move the K tank from one front to another, it would have been necessary to dismantle it into four or five sections, each piece being carried on one car. The French Char 2-C, forerunner of the 3-C, was transported by rail on special low-slung channel irons mounted on 3-axle trucks. To load the tank, one truck was withdrawn, and the tank was run onto the channel irons. These were then jacked up and the truck replaced.

Heigl's "Taschenbuch der Tanks" (1935) states that the Char 3-C moved by rail on wheel trucks lowered by motor from the body of the tank. Presumably, after the tank had been jacked up to clear the rails, it could move under its own power by means of electric motors on the wheel trucks. (The Char 3-C is gas-electric powered.) There is some question as to whether or not the technical difficulties of this method were solved by the French. Considering the two basic missions of the heavy tank, only the last method is satisfactory. The German method of transporting the K tank is obviously unsound. Standard flatcars can be used only if they can carry the load (there are relatively few with a capacity of over eighty tons) and if the height of the loaded tank does not exceed permissible tunnel clearances. Specially designed cars are just another difficult item to procure. Other important factors are the time required to assemble rail equipment and its vulnerability to modern bombardment. To assemble the tanks for the Battle of Cambrai required thirty-six trains of twelve flatcars each. Aërial bombing might have delayed the assembly for hours or even days. Such a delay would be fatal to tanks moving to stop a break-through.

To summarize briefly: The heavy break-through tank must move by rail. Rail trucks mounted integrally in the tank are the ideal solution if the technical problems can be met. For long distances, when not subject to hostile interference, several tanks would be drawn by a locomotive. At other times they would move on rails under their own power or pass around obstructions on their own tracks. This would enable heavy tanks to keep close behind advancing armored divisions to support them if secondary defense systems were encountered.

History offers several examples of the use of heavy tanks both in break-through operations and in counterattack against hostile heavy tanks. The following two are selected not only to illustrate tactical methods but to shed considerable light on the technical characteristics necessary to insure battle success.

THE Battle of Cambrai was the "trial by fire" of the British Tank Corps. For the preceding year their combat successes had been negligible. The tanks now either had to win a smashing victory or be classed as ineffective. The personnel of the Tank Corps rose grandly to the occasion and with the coöperation of Gen. Sir Julian Byng planned to open up a hole in the famed Hindenburg Line. At this point the Allied high command, still lacking faith in the ability of tanks, failed to mass a mobile force capable of exploiting the gap. True, a cavalry corps was provided, but it was just as vulnerable to the fire of machine guns on one side of the gap as the other.

For the break-through, General Byng and General Elles, the Tank Corps commander, had available 6 infantry divisions, 1,000 guns, 378 fighting tanks and 98 administrative vehicles. The latter were earlier-model tanks which had been converted to cross-country transports. Opposing this force was the Hindenburg Line consisting of three wide trench systems, each protected by 50-yard bands of barbed and saw-tooth wire, the direct fire of forward 77-mm. gun batteries, concrete pillboxes and the natural obstacles formed by the Canal de l'Escaut and the Grand Ravine. The Canal de l'Escaut was bridged in several places and it was hoped that these structures could be captured intact. The Grand Ravine was thought to be an even more formidable obstacle for it appeared from aërial photographs to be impassable to tanks. In reality it proved no obstacle at all.

| TYPE | DATE | ARMOR | ARMAMENT | WEIGHT |
|---|---|---|---|---|
| *American* Mark VIII... | 1919 | 0.236" to 0.63" | 2 – 57-mm. guns<br>5 – machine guns | 43.5 tons |
| *British* Mark V..... | 1918 | 0.2" to 0.47" | 2 – 57-mm. guns<br>4 – machine guns | 31.9 tons |
| Independent. | 1926 | 0.78" to 1.0" | 1 – 47-mm. gun<br>5 – machine guns | 33.6 tons |
| *French* Schneider.... | 1919 | Unknown | 4 – 75-mm. guns<br>9 – machine guns | 128 to 141 tons |
| Char 3-C.... | 1926 | 0.9" to 2.12" | 1 – 155-mm. gun<br>1 – 75-mm. gun<br>4 – machine guns | 81.5 tons |
| D..... | 1928 (?) | 1.39" | 1 – 155-mm. howitzer<br>2 – 75-mm. guns<br>1 – 105-mm. gun<br>11 – machine guns | (?) |
| *German* A7V..... | 1918 | 0.59" to 1.18" | 1 – 57-mm. gun<br>6 – machine guns | 33 tons |
| K..... | 1918 | 0.39" to 1.18" | 4 – 77-mm. guns<br>6 – machine guns | 165.3 tons |
| *Italian* T 2000..... | 1918 | 0.59" to 0.787" | 1 – 65-mm. gun<br>7 – machine guns | 44 tons |
| GL4..... | 1928 (?) | Unknown | 1 – 75-mm. gun<br>Several machine guns | 38.5 tons |
| *Russian* TG5/T42.... | 1926 (?) | 2.95" | 1 – 105-mm. gun<br>2 – 37-mm. guns<br>2 – antiaircraft machine guns | 110 tons |

CHARACTERISTICS OF WORLD WAR BREAK-THROUGH TANKS

It is obvious that no matter what the spanning ability of a break-through tank may be, a trench can be dug that is just too wide. The Mark IV tank could span ten feet, but the Hindenburg trenches had an effective width of sixteen to eighteen feet. To overcome these trenches, huge fascines, weighing 1½ tons each, were built for 350 of the tanks engaged. These fascines were carried on the forward nose of the vehicle and could be released by the crew from inside the tank.

A rather novel scheme was worked out for getting the tanks across all three trench systems and at the same time providing protection for the advancing infantry. The lead tank of each group of three, acting as advance guard, had the mission of protecting the other two vehicles and the accompanying infantry as they crossed the first trench. The advance-guard tank crossed and crushed the wire, turned left and dominated the first trench by fire. The second tank, laying its fascine, crossed the trench, turned left and supported the action of the advance-guard tank. The third tank crossed on the fascine, proceeded to the second trench, crossed, turned left and covered the advance of the infantry and the advance-guard tank. Its first mission accomplished, the advance-guard tank laid the fascine for the crossing of the third trench. Later in the war, British engineers and tank troops collaborated in designing a portable steel-girder bridge which could span twenty-four feet and be carried, mounted at an angle of forty-five degrees, above the nose of the tank. While this device was not tested in combat, it should not be lost sight of for special operations. The necessary brackets for carrying such a bridge should be provided on all future break-through tanks and a limited number of bridges kept in tank depots for use as needed.

The wire obstacles of the Hindenburg Line were easily crushed by the tanks and the infantry had no trouble in passing through the gaps. To facilitate the passage of horses, some of the tanks were provided with grapnels for towing the wire out of the way. This method was not satisfactory for often an amount of wire dangerous to horses was left untouched. In the recent Battle of France it is believed that the German high-heat flame throwers were used not only to attack the gun bunkers and machine-gun pillboxes, but also to melt or soften the high-tensile wire obstacles and upended steel rails of the Maginot Line. The concrete posts, so often depicted as the ultimate in tank barriers, probably were blown to ineffectiveness by the close-range fire of the tanks' heavy cannon. In designing a heavy tank it is important to eliminate all projections which will catch wire and foul the track. Even the most powerful tank can be stopped by wire tangling between track and drive sprocket.

THE British tanks fared well against the natural and man-made obstacles of the Hindenburg Line but lost heavily in their encounter with the German artillery. They scored only two notable successes. Once when a tank had one of its sponsons partly blown off by a 5.9-inch howitzer it continued the attack and crushed the German gun before the crew could reload. The other instance occurred when a tank unexpectedly found itself facing four German field guns. The tank charged. There were three wild shots from the battery, then a hit on the upper cab of the tank. The tank stopped, its crew dazed, but in a few seconds it advanced again. The tank's machine gunners shot down the gun crews before they could obtain another hit.

These successes by the tanks against artillery were offset by heavy losses. There is a legend that at the village of Flesquières a lone German officer, the only survivor of his battery, served his gun and accounted for sixteen tanks as they

topped a ridge. The report of a British intelligence officer who studied the battlefield immediately after the attack moved forward states that there were only five derelict tanks and that they had been up against three gun batteries. Of course the intelligence officer had no way of knowing how many of these guns were served.

The really important point of the story is the fact that the British Mark IV tanks did not carry sufficient armor to protect them from cannon fire. In the recent Battle of France, the French heavy tank, Char 3-C and, from battle indications, the German break-through tank, carried sufficient armor to protect them not only from all antitank gunfire but from most hits by a field piece. The track is, of course, still the Achilles heel of the tank.

At Cambrai, no serious difficulty was experienced by the tanks from land mines, although some were encountered. Later in the war, the Germans made considerable use of mines, and the British, to counter this, evolved a special device to protect their tanks. A heavy steel roller, slightly wider than the tank's tread, was pushed ahead of the tank. Its ground pressure was materially greater than that of the tank, insuring that mines would be detonated at a safe distance from the tank. There is, unfortunately, no battle record of the success or failure of this simple and useful expedient.

Before Cambrai, the preparations made to insure full cooperation between the infantry and the tanks were elaborate and were carried to the extent of having the tanks train against obstacles built by their own infantry. The tanks crossed them all without difficulty, giving the assault troops great confidence. These measures were deemed necessary because of the poor coördination of the two arms in earlier tank battles. The infantry was divided into three groups designated as "trench clearers," "trench stops," and "trench garrisons." Only at one point did this plan break down. One of the infantry division commanders thought the whole scheme a lot of nonsense—his own plan allowed the infantry to fall too far behind and be decimated by a few machine guns overlooked by the tanks.

At the Battle of Amiens on August 8, 1918, even more thorough arrangements were made to insure infantry-tank coöperation. Today, the Germans, again taking a leaf from the pages of British history, apparently have welded their assault troops and break-through tanks into a single combat unit. Regular infantry and armored divisions exploit the successes of the "task" troops.

One more incident of interest remains. A British tank, in attempting to capture a bridge before it could be blown up by a German officer, had to dismount two members of its crew armed with revolvers. In modern practice, the tank crew would have one or more submachine guns for dismounted action. For special operations, a small squad of assault troops might be carried in addition to the regular crew.

To sum up, the greatest tactical error made by the British at Amiens was in not holding out some of their tanks as a reserve for the second day of operations in case the gap was not opened on the first day—as it was not. The crews were so exhausted after the first attack that their effect on the rest of the battle was negligible. Technically, it is apparent that break-through tanks must have the maximum possible spanning ability consistent with other design factors and have readily available special means if this does not suffice. Armor protection must be sufficient to stop all normal antitank projectiles and must provide some protection even from direct hits of fieldpieces. Coöperation between specially trained and equipped assault troops and break-through tanks is axiomatic.

THE Battle of Villers-Bretonneux, April 24, 1918, while relatively small as far as tanks are concerned, is important not alone because it was the first tank-versus-tank battle, but because it illustrates the use of heavy tanks in a counterattack against hostile break-through tanks. The German tank forces during the World War consisted of twenty A7V tanks and a number of captured British heavies which had been reconditioned. During this phase of the great spring offensive, the German high command detailed fourteen A7V tanks to support the attack of three infantry divisions. The British tanks engaged consisted of two Mark IV tanks armed with machine guns only, one Mark IV tank armed with two 57-mm. cannon in addition to machine guns, and seven Whippet tanks armed only with machine guns.

In this battle the Germans, contrary to the British policy of attaching tanks, placed their units in support of the infantry. The two were to proceed to their objective in company, cleaning out trenches and fortified strong points as they went, then the tanks were to return to their assault positions. The German tank units were unaware of the presence of any British tank units. This fact partly explains why several German tanks proceeded blindly on their missions while hostile tanks were active only a few hundred yards away. The Germans were not expecting a counterattack.

The British, acting on vague rumors that the Germans planned to use tanks against Villers-Bretonneux, moved three heavies and seven Whippets to concealed positions on the Bois d'Aquennes.

It was not until four hours after the German attack was launched that Capt. F. C. Brown, commanding the British heavies, knew that the Germans actually were using tanks. He was moving his company toward Cachy when some of the German machines were encountered. Only one German tank opened fire on the British. This tank, moving rapidly to a defiladed position, accounted for one of the British machine-gun tanks but was itself put out of action by the British cannon tank. While the second machine-gun tank drove for the shelter of the woods, the British cannon tank was knocked out by an advanced German field piece. The other three German tanks did not see the action and, after taking their objective, retired behind the German lines. Further to the south, a single German tank encountered seven Whippets deployed and moving toward Cachy for the purpose of "clearing up the situation." The German tank accounted for two of the British machines. A third, while moving away from the action, was knocked into a hole by shell fire. The crew was shot down trying to abandon the vehicle. The remaining four Whippets made good their escape.

The vital lesson of this engagement is "don't send a boy to do a man's job." Of the ten British tanks engaged, only one had even a small chance of success. In a break-through tank, fire power plus armor protection is more important than battlefield speed. The British and French learned this lesson too late when their light vehicles encountered German mediums and heavies in the Battle of Flanders. Only the break-through tank, properly combined with other arms, can stop a hostile penetration or effect a break-through and insure freedom of action to armored divisions.

# ARMY ORDNANCE

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## Month by Month

THERE IS A TRADITIONAL ORDNANCE ATTITUDE in a recent statement of labor policy adopted by the National Defense Advisory Commission in connection with the defense effort:

Primary among the objectives of the Advisory Commission to the Council of National Defense is the increase in production of materials required by our armed forces and the assurance of adequate future supply of such materials with the least possible disturbance to production of supplies for the civilian population. The scope of our present program entails bringing into production many of our unused resources of agriculture, manufacturing, and man power. This program can be used in the public interest as a vehicle to reduce unemployment and otherwise strengthen the human fiber of our nation. In the selection of plant locations for new production, in the interest of national defense, great weight must be given to this factor.

In order that surplus and unemployed labor may be absorbed in the defense program, all reasonable efforts should be made to avoid hours in excess of forty per week. However, in emergencies or where the needs of the national defense cannot otherwise be met, exceptions to this standard should be permitted. When the requirements of the defense program make it necessary to work in excess of these hours, or where work is required on Saturdays, Sundays, or holidays, overtime should be paid in accordance with the local recognized practices.

The Commission reaffirms the principles enunciated by Maj. Gen. William Crozier, Chief of Ordnance of the United States Army early in the World War, in his order of November 15, 1917, relative to the relation of labor standards to efficient production: "In view of the urgent necessity for a prompt increase in the volume of production . . . vigilance is demanded of all those in any way associated with industry lest the safeguards with which the people of this country have sought to protect labor should be unwisely and unnecessarily broken down. It is a fair assumption that for the most part these safeguards are the mechanisms of efficiency. Industrial history proves that reasonable hours, fair working conditions, and a proper wage scale are essential to high production. . . . Every attempt should be made to conserve in every way possible all our achievements in the way of social betterment. But the pressing argument for maintaining industrial safeguards in the present emergency is that they actually contribute to efficiency."

THE PLAN OF COÖPERATION BETWEEN THE Government and private manufacturers for construction of new plants and additions necessary to speed up production of defense materials has many noteworthy aspects. This plan, adopted by the National Defense Advisory Commission, represents striking progress in the evolution of Government procurement methods. It was prepared by the Commission and adopted after consultation with the War and Navy Departments and the Comptroller General. In substance, it offers what might be described as a bankable contract—one which will permit contractors to finance the expanded facilities through use of their own funds or the granting of credit from private sources.

Specifically, it has two purposes: First, to expedite signing of supplies contracts by assuring the contractor against loss on construction undertaken for military purposes; secondly, it safeguards the Government's interest in such facilities on termination or completion of the contract. The Government's residual interest upon such termination is to be evaluated by the usual board of three appraisers, one appointed by the Government, one by the contractor and the third by the senior judge of the Circuit Court of Appeals of that circuit wherein the facilities are located.

Under this plan it is further provided that the Government reimburse the contractor, not in additions to the unit price of the product purchased as heretofore, but in five equal annual installments covering the amount of his capital expansion costs as audited by approved certified accountants. Thus, cost of supplies and amortization by the Government of construction cost would be separated.

Upon passage of the Defense Appropriation Bill, tax and amortization legislation having been adopted by Congress, contracts involving the major procurement program are being placed with all the speed consistent with systematic and orderly purchasing. Adoption of this plan assures that neither the private manufacturer nor the Government would assume in advance all the risk, nor subsequently reap as a profit the residual value. Should the manufacturer be unable to use the property at the final determined valuation, the Government then would take title, use the property for its own needs, hold it for emergency reserve capacity, sell it, or dismantle and salvage.

It is expected that the plan will conserve Government funds and stimulate investment of private capital in the defense construction program. At the same time, private manufacturers would provide management and operation and assume all the ordinary risks of the business. Government participation would be limited to actual expansion costs. Final adjust-

ment of fair value would reimburse the Government to the extent of the residual value of the property.

Pursuant to these views, the National Defense Advisory Commission made public a statement of principles governing the letting of contracts for defense materials.

The essence of the preparedness program is the getting of an adequate supply of materials of the proper quality in the shortest space of time possible. Considerations of price alone are highly important, but in the emergency are not governing.

Speed of delivery of all items on the defense program is essential. This means: (1) That orders should be placed in such a manner as to insure the most efficient use of each particular facility from the point of view of the program as a whole; (2) That proper consideration should be given to contributory industries, such as the machine-tool industry, to avoid creating underlying bottlenecks; (3) That once delivery dates are fixed, assurance be given that they will be met by the supplier.

Proper quality is also of prime importance. It is therefore necessary to determine, first of all, whether or not the supplier can meet the quality requirements, as specified. There should be a willingness on the part of both the Army and Navy, on the one hand, and of the supplier on the other, to adjust specifications on a coöperative basis in order that such specifications may come as near as possible to meeting commercial standards while at the same time fulfilling the military requirements. Price, while not the sole consideration, is of outstanding significance, and every effort must be made to secure a fair price. This must take recognition, among other things, of determination of proper cost factors.

The impact of the defense program upon the consumers must be recognized. This relates to such factors as: Due regard to the necessity of protecting civilian needs and morale; proper health and housing conditions among employees; consideration to possible off-season production in order to dovetail the military program into production for civilian requirements. Off-season production also should lead to lower overhead and consequently to lower prices for both the consumers and the Government.

Adequate consideration must be given to labor. This means compliance with the principles on this subject as outlined by the Commission and sustained by the courts.

Financial responsibility of the supplier should be examined. Ability to post a bond does not necessarily dispose of this problem. The probability should exist that the supplier will be able to continue in business, at least long enough to complete his contract satisfactorily. Further, an ability to finance himself through private sources should take preference over necessity for securing Government aid.

The avoidance of congestion of transportation and warehousing facilities should be sought. Due consideration should be given to the adequacy of power facilities, particularly where furnished by public utilities. A general preference should be given to firms having experience with educational orders.

The moral responsibility of the supplier is important, and in some respects, fundamental. There should be evidence of his honest, sincere desire to coöperate with the Army and Navy in producing what is called for, and on time, without profiteering; to assume some risks himself rather than attempt to shift all such risks to the Government; and to furnish a correct statement as to his capacity and his experience. The supplier's general standing and reputation among reputable business men (as distinct from his financial rating) are an index of such qualifications.

The Commission recognizes that competitive bidding is the better procedure in certain types of industry and circumstances. However, it is often impossible to make sure that the principles outlined above are followed when contracts are placed on the basis of price alone and are let to the lowest bidder. Therefore, in cases where competitive bidding will not fulfill the above-stated needs of national defense, the Commission recommends that the use of the negotiated contract be authorized where necessary in order that these objectives be obtained in making defense purchases.

All these policies the War Department (and in a very particular way, the Ordnance Department) has been following for many, many years. It is encouraging and decidedly reassuring for the country at large to have the experts of the National Defense Advisory Commission pronounce them good!



THANKS TO THE FORESIGHT AND GOOD SENSE of ordnance planning in years past, the system of decentralized operation of the vast military armament organization in time of emergency has been put into active operation with little or no difficulty. In fact, the transition has happened without fanfare and in an atmosphere decidedly devoid of undue publicity. More than a month before the Congress, after lengthy debate, passed the necessary legislation in early September, the Ordnance district chiefs, assistant chiefs, and executive officers were brought to Washington by the Chief of Ordnance to receive their instructions. Later, when the enabling legislation was enacted, the fourteen Ordnance districts were activated and the huge task of operating the rearmament program went into full swing.

The Ordnance districts had been planning for such an emergency for the past twenty years. The ease with which they undertook the task has been most heartening. The leadership, both on the part of the civilian chiefs and the officers of the Regular Establishment who serve as executive officers, has been exemplary. The result was that, within a very short time after legislation was passed, the system of allocations, production, and inspection was geared to the increased demands.

Similarly, the arsenals of the Ordnance Department have been geared to faster speed. The arsenals are the very bone and sinew of all ordnance progress. The alacrity with which their commanders undertook the change to a 3-shift basis has encouraged all observers. In a short time now, the results of this transition will be reflected directly by the increased quantities of equipment for our new citizen armies.

All this portends a smooth and effective organization to carry on the job of ordnance production throughout the country. It signifies, as never before, the value of the closest coöperative ties between the Army and industry. Whether or not there be weightier responsibilities ahead, the application of the principles of industrial preparedness to the present job has proved both the inherent wisdom and the broad foresight of industrial preparedness as we have come to know it. More than that, the activation of the Ordnance districts is the best proof of a lesson learned by our people two decades ago; *i.e.*, in time of emergency the less centralized control the better—the more decentralized operation the better still.

# Momentum

## An Editorial

THE forward motion of our military rearmament now reflects the increases in volume and velocity authorized by the Congress early in September. Because of inherent inertia the program was difficult to get started; for the same reason its speed will increase each day if the outlook and earnestness of those who are at the helm remain alert and sensible. It is no easy thing to gear the tremendous power of American industry to any one effort—the national defense being no exception. But once geared, there is every reason to expect that rearmament will progress in increasing ratio from day to day.

Three extremely dependable indices of this momentum were given to the American public at the Twenty-first Annual Meeting of the Army Ordnance Association at the Waldorf-Astoria in New York on October 8, 1940. An account of this meeting is published elsewhere in these pages. The several addresses which were given by outstanding authorities in the fields of ordnance technology and the national defense generally will be published in full in the next issue. Meanwhile these indices are heartening because they present factually the satisfactory degree of progress thus far made in rearming the fast-growing Army and Navy of the United States.

THE first of these assurances came from the Assistant Secretary of War, Hon. Robert P. Patterson, speaking before more than 1,500 members and guests of the society in annual meeting. Judge Patterson's assurance was that sound common sense is in the saddle and that daydreaming nonentities will not be allowed to molest the military-industrial effort despite their zealous theories—social or otherwise. Judge Patterson said: "Speed of production is the need of the hour. Whatever interferes with speed must be pushed out of the way. In the War Department we are resolved that red tape shall not delay us, that complicated and time-consuming procedures shall be simplified, that momentum shall be maintained in the placing of orders as well as in the acceptance of deliveries. When legal obstacles are encountered, ways will be found to remove them. You may depend on it that the national defense will not bog down by reason of administrative action."

The second assurance came from Maj. Gen. C. M. Wesson, Chief of Ordnance of the Army. His was a straight-from-the-shoulder statement of work done. It epitomized a tremendous amount of energy and good sense used by this great administrator and by the many exceptionally capable officers and civilians of his staff. General Wesson said: "Now as to production: The 1939 appropriation of $50,000,000 for armament has been converted into guns and ammunition and tanks. The 1940 appropriation of $130,000,000 was promptly obligated, and production on this program commenced a few months ago and is rapidly increasing each day. The current Ordnance program represented by the 1941 appropriation has a money value of approximately $2,000,000,000. Three-quarters of this amount did not become available until September 9th, and today, one month later, approximately 70 per cent of the total program has been placed with industry and the arsenals. The great bulk of contracts not yet placed apply to the products of some fifteen new Government plants which will not be ready for operation for approximately one year."

The third assurance came on the same occasion in the disarming simplicity and frankness of the great William S. Knudsen, chief of production, National Defense Advisory Commission. Mr. Knudsen cited facts and figures of defense progress which should hearten every man, woman and child in the United States. Mr. Knudsen said: "The amount of contracts cleared up to and including September 28th was $3,153,000,000 for the Army, and $5,100,000,000 for the Navy, or a total of $8,253,000,000, with approximately $4,000,000,000 to go. The balance of the $16,000,000,000 expenditure provided by Congress includes pay of Army and Navy, food, travel, and other items we don't clear."

HERE then are proofs that the momentum of the national-defense program is gaining in satisfactory measure. Which is as it should be. For the Army and Navy of the United States long have been at work on the defense problems of which the American people are at last conscious. What is being done is being done according to plan. The plan has been evolved from the best minds in the fields of management, labor, industry, the engineering professions and the military service. The plan is a compendium of the best thought of America on national defense, prepared at a time when only an insignificant number of our people were mindful that there was such a thing as national defense to worry about. Again quoting from General Wesson's address at our Twenty-first Annual Meeting—"Read the reports of my distinguished predecessor, Maj. Gen. William Crozier, Chief of Ordnance, 1901-1918, whom we are so glad to see here tonight. His was a voice in the wilderness in proclaiming the necessity for accumulating stocks of war matériel, because of the time required to produce them. That our needs should be foreseen and planned for well in advance of the time required is, gentlemen, a doctrine we of the Ordnance Department have understood for years. But it is a doctrine most people do not accept until stark reality dawns upon them! Traditionally we temporize with our strength. Other nations have had this same failing. The Greeks had a name for it—'Whistling in the dark'! With an understanding of its responsibilities and with the whole-hearted coöperation of American industry, a sound plan has been constructed by the War Department. In these days the American people can be assured of that fact. We have not been caught napping—no matter who says so!"

One difficulty has been that many commentators have been talking about defense conditions when they have known next to nothing of the facts. Some of them are determined to view the present situation in the light of our World War unpreparedness. They just will not believe that there has been a small segment of industry and the Army which has kept the torch of industrial preparedness aglow during long years of darkness. The result is plainly to be seen. With each passing week visibility will improve.

And because of these happenings in the immediate and the distant past, the momentum of our rearmament effort progresses along lines which are defensively sound. L. A. C.

# Association Affairs

## TWENTY-FIRST ANNUAL MEETING

TO the strains of the National Anthem, in the beautiful ball room of the Waldorf-Astoria Hotel, New York City, on the evening of Tuesday, October 8, 1940, 1,554 members and guests of the Army Ordnance Association assembled for the Twenty-first Annual Dinner. This spectacle was the fitting climax to a day of meetings and discussions memorable by their timeliness, sincerity and spontaneity. Brig. Gen. Benedict Crowell, president of the Association, presided at the dinner. Addresses were given by Maj. Gen. C. M. Wesson, Chief of Ordnance, United States Army; Hon. Robert P. Patterson, the Assistant Secretary of War, and Hon. William S. Knudsen, chief of production, National Defense Advisory Commission. Never before in the history of the society had there been so large and distinctive a gathering, representative of Ordnance power in American industry and the national defense.

All the addresses given at the several sessions of the Twenty-first Annual Meeting will be published in full in the next issue of ARMY ORDNANCE. It is regretted that there was not time enough before going to press to include them in this issue.

At 9:30 A.M., headquarters of the Association were opened in the East Foyer of the Waldorf for registration. The technical and engineering session followed at 10:30 in the Astor Gallery. At this session, Col. William W. Coleman, of Milwaukee, Wis., vice-president of the Association, presided. Brig. Gen. Earl McFarland, Assistant to the Chief of Ordnance and head of the Military Service of the Ordnance Department, was chairman. Technical papers were read by Brig. Gen. R. H. Somers, chief of the Technical Staff, Office of the Chief of Ordnance, former secretary of the Army Ordnance Association and editor of ARMY ORDNANCE. General Somers spoke on "Antitank and Antiaircraft Cannon." "Artillery Ammunition" was the title of a paper presented by Col. H. H. Zornig, long identified with that subject and now on duty at the Aberdeen Proving Ground. Lieut. Col. J. K. Christmas, also of Aberdeen Proving Ground, presented an illustrated lecture on "Tanks," a subject with which he has been intimately associated through the long period of development and production.

This session was followed at 12:30 P.M. by an industrial-mobilization luncheon at which 683 members and guests were in attendance. The luncheon was originally scheduled to be held in the Jade Room of the Waldorf, but the large attendance made it necessary to hold this function in the main ball room. Brig. Gen. Samuel McRoberts, president, New York Post, Army Ordnance Association, and chief of the New York Ordnance District, presided at the luncheon. The address at the luncheon was by Hon. Lewis Compton, Assistant Secretary of the Navy, who spoke on "Industrial Mobilization and the Navy." Secretary Compton's address was most timely and was much appreciated by his large audience.

A military rearmament round table followed immediately. Col. Frederick H. Payne, vice-president, Army Ordnance Association, and chief of the Hartford Ordnance District, presided. Brig. Gen. C. T. Harris, Jr., Assistant to the Chief of Ordnance and chief of the Industrial Service, Ordnance Department, was chairman. At this session, Maj. Gen. James H. Burns, executive to the Assistant Secretary of War, spoke on "Ordnance Procurement"; Brig. Gen. Burton O. Lewis, special assistant for production, Industrial Service, Office of the Chief of Ordnance, spoke on "Ordnance Production"; "Ordnance Engineering" was the topic of Brig. Gen. G. M. Barnes, special assistant for engineering, Industrial Service, Office of the Chief of Ordnance, while Brig. Gen. L. H. Campbell, Jr., special assistant for plant facilities, Industrial Service, Office of the Chief of Ordnance, spoke on "Ordnance Facilities." A question-and-answer period followed.

At 6:30 P.M. a reception for honor guests was held in the Basildon Room of the Waldorf. Promptly at 7:15 the vast assemblage entered the ball room for the Twenty-first Annual Dinner. Covers were set for 1,554, and the great room and its two balconies were filled completely. Music was by the Waldorf-Astoria orchestra. Several of the addresses were broadcast over a coast-to-coast network by courtesy of the Mutual Broadcasting System.

Seated at the speakers' table (in the order of seating) were the following distinguished guests: *Dais A*—Brig. Gen. John Ross Delafield, counsel, Army Ordnance Association; Col. Theodore Swann, director, Army Ordnance Association; William C. Dickerman, director, Army Ordnance Association; Maj. Gen. William H. Tschappat, former Chief of Ordnance, United States Army; General McRoberts; General McFarland; Colonel Coleman; Rear Adm. Clark H. Woodward, commandant, Navy Yard, Brooklyn, N. Y.; Bernard M. Baruch, former chairman, War Industries Board; Maj. Gen. C. C. Williams, former Chief of Ordnance, United States Army; General Wesson; Secretary Patterson; General Crowell; Mr. Knudsen; Lieut. Gen. Hugh A. Drum, commanding general, the First Army; Maj. Gen. William Crozier, former Chief of Ordnance, United States Army; Colonel Payne; General Harris; Col. Frank A. Scott, director, Army Ordnance Association; Col. Robert P. Lamont, director, Army Ordnance Association; Col. Charles H. Tenney, director, Army Ordnance Association; Brig. Gen. Chas. Elliot Warren, treasurer, Army Ordnance Association; and Col. James L. Walsh, director, Army Ordnance Association.

*Dais B*—Howard Coonley, New York Committee, Army Ordnance Association; Erwin R. Davenport, chief, Rochester Ordnance District; R. E. Gillmor, New York Committee, Army Ordnance Association; General Somers; Samuel Kahn, chief, San Francisco Ordnance District; Col. Gene Tunney, New York Committee, Army Ordnance Association; Col. Winthrop Withington, chief, Cleveland Ordnance District; Malcolm Muir, New York Committee, Army Ordnance Association; Frank B. Bell, chief, Pittsburgh Ordnance District; Col. Thomas F. Brown, chairman, New York Committee, Army Ordnance Association; Charles J. Hardy, New York Committee, Army Ordnance Association; Edward A. Muller, chief, Cincinnati Ordnance District; Fred A. Preston, chief, Chicago Ordnance District; Col. James E. McNary, New York Committee, Army Ordnance Association; C. Jared Ingersoll, chief, Philadelphia Ordnance District; Col. Crosby Field, New York Committee, Army Ordnance Association; Frank W. Steere, assistant chief, Detroit Ordnance District; Thomas E. Murray, New York Committee, Army Ordnance Association, and John A. Zellers, New York Committee, Army Ordnance Association.

*Dais C*—The following members of the New York Committee, Army Ordnance Association: Harry A. Campbell, Lieut. Col. C. E. Davies, Thomas P. Durell, Lieut. Col. W. John Hoffmann, A. E. Van Cleve, Col. John J. Dooley, Charles F. Radley, Lieut. Col. Charles McKnight, H. Hobart Porter, Hartley W. Barclay, C. Donald Dallas, James R. White, Maj. C. Stewart Comeaux, Cyrus H. Loutrel, and H. M. Tillinghast.

The Twenty-first Annual Meeting of the society was historic in many respects, not the least of which was the evidence it furnished to the nation at large of the fine spirit of understanding and coöperation which exists between American industry and the national defense—upon the strength of which bond rests the greatest assurance of America's ability to defend herself.

While all the addresses at the meeting will be published in the next issue, the predominant note of the occasion—industrial mobilization—can be gotten from the remarks of the three officers of the Association who presided at the several functions. In

calling the meeting to order for the morning session Colonel Coleman, vice-president, said:

"I am very happy to open this, the first session of the Twenty-first Annual Meeting of the Army Ordnance Association. Twenty-first birthdays are always happy occasions. Especially is this so when a nation-wide society, dedicated to the national defense of the United States, attains its majority. It is a unique thing too that those of us who started out with the Association as national officers also attain our majority in office. I can scarcely believe it, but twenty-one years have elapsed since I first assumed the office of vice-president.

"Hence I take especial pride in welcoming you to this meeting. We have arranged a program which, in the light of past experience and future possibilities, may be historic. We propose to discuss some of the principal aspects of our military armament from all its various viewpoints: design, procurement, production, and maintenance. Thus we have divided our program for the day into two main divisions. Here this morning we are to have a technical and engineering session. This afternoon we are to have a military rearmament round table. At luncheon, industrial mobilization will be the theme, and at our twenty-first annual dinner tonight, production for defense will be the keynote.

"My function at this meeting this morning is merely to preside. The Ordnance Department of the Army has provided some of its most capable engineers to do the talking. It has also provided one of my old friends, General McFarland, Assistant to the Chief of Ordnance, who will be chairman of this meeting. Without further ado I take great pleasure in turning over the meeting to Brig. Gen. Earl McFarland, Assistant to the Chief of Ordnance."

Similarly, Colonel Payne, who presided at the military rearmament round table in the afternoon, in calling that meeting to order said:

"I had no idea when I accepted the very pleasant assignment of presiding at this military rearmament round table that the whole complexion of the lineup would change so completely within ten days. I thought at the time that we would have one general on the program, ably assisted by four outstanding colonels. Overnight that set-up has changed upward! We now have five generals participating in this round table. Incidentally it should be said in fairness to our program committee that it knows how to pick the right people!

"My job this afternoon is both pleasant and brief. It is pleasant because I am afforded an opportunity to welcome you all to this, the third session of our Twenty-first Annual Meeting. Your presence here is itself the best indication that the things we have assembled to discuss are important. I will be brief because there is a lot of ground to cover and we have the best experts there are here with us to cover it. Anyway a mere colonel has got to be brief in the presence of five generals! So after just one word of salutation I will turn this meeting over to General Harris.

"My salutation is to the five new generals who are on our program. Just about a week ago the announcement was made that these officers had been chosen to be generals. They occupy places of highest importance in the whole military rearmament set-up. If it be said that their new rank goes with the office, that will be a fair statement of fact. But it also must be said that every one of them is decidedly worthy by experience, ability, and energy. So I want to take this opportunity to congratulate these officers on my own behalf and on yours. I imagine this is the first time they have been together for a public appearance. So an otherwise historic meeting makes history in yet another way. With my congratulations I offer in your name sincerest greetings to our new generals for many happy days and every success."

Lastly, Brig. Gen. Benedict Crowell, president of the Association, in addressing the more than fifteen hundred members and guests at the Twenty-first Annual Dinner said:

"Mr. Secretary, distinguished guests and gentlemen. It gives me a great deal of pleasure and satisfaction to welcome you to this, the Twenty-first Annual Dinner of the Army Ordnance Association. This is the largest gathering we have ever had in twenty-one years. But regardless of size, our meeting tonight is historic because it coincides with the greatest peace-time military armament effort in the history of our country.

"For the past twenty years the Army Ordnance Association has been pleading for industrial preparedness. Tonight it can survey our rearmament with some degree of satisfaction. And it is to present such a survey that we have invited our distinguished speakers here to address us.

"Let me therefore welcome you all most heartily—our guests, our members and their guests—and let me felicitate you one and all. Your presence here is itself conclusive evidence of your determination to help in every way possible to bring the national defense of the United States to that degree of strength which the times require.

"It is now my pleasure to introduce the first speaker on this program, the Twenty-first Annual Meeting of the Army Ordnance Association. Our Association, numbering more than 6,000 executives and engineers of American industry, is pledged to industrial preparedness as our strongest guaranty of peace. You who are gathered here, more than 1,500 strong, are men who are intimately familiar with the problems of modern industrial production. You are the men who make the things America uses in peace; you are the men who make the things America must have if her national defense is to be adequate. You are the men who *are* American industry. To you much of our progress is due for our comforts and conveniences.

"This is an occasion which I have long awaited. It is the opportunity to present to you an officer of the United States Army whose close friendship I have valued for many many years. Historians have remarked on more than one occasion that America in time of emergency seems to be blessed by a special Providential watchfulness. In time of great stress it seems that the American genius brings forth men who are particularly skilled in doing the great job that is to be done. Without any sense of flattery whatever I feel deeply that such is the case in the man who now guides the very important destinies of supplying our Army with its fighting equipment. He is Chief of Ordnance of the United States Army. During all the years he has been a leading exponent of industrial preparedness. He has held offices of highest responsibility here and abroad. We of the Army Ordnance Association remember him well as the commanding officer of the Aberdeen Proving Ground on many of our annual visits to that great establishment. In 1938 he was chosen by the President to be Chief of Ordnance. That was an important day for armament preparedness.

"Gentlemen, I present to you the man who is the guiding spirit and the inspiration of our great present Ordnance undertaking, Maj. Gen. C. M. Wesson, Chief of Ordnance, U. S. Army."

Following General Wesson's address General Crowell said:

"And now, gentlemen, I present to you the Assistant Secretary of War. In the short time he has been in office he has done great things for the military establishment. He brings to his important task two characteristics, both of which fit in perfectly with his duties. The one is his judicial temperament, the other is his military service in peace and in war. For his war service he has been decorated for gallantry under fire. For his judicial ability he was elevated to a high post among the Federal judiciary. Two months ago he left the Federal bench to take up his duties as Assistant to Colonel Stimson, the Secretary of War. Industrial preparedness has always been the leading responsibility of the Assistant Secretary of War. Industrial preparedness is the principal responsibility of the Army Ordnance Association."

In introducing Mr. Knudsen, General Crowell said: "There is one man in the United States who typifies American industry today in a special way. His name is William S. Knudsen. He has done great things for America, and he is doing greater things now for our fighting forces. In a manner characteristic of American industry he answered the call to national service at a

time of great need. Without thought of personal sacrifice either to himself or to the great organization with which his name is synonymous, he came to Washington to help coördinate industrial production of our fighting forces whose one demand, so far as fighting equipment is concerned, is 'Production and yet more production.' He has the genius of working with people. He knows the value of teamwork. What he is doing in Washington by working with the defense services is truly inspiring. . . . His ideal now is production for defense."

### ELECTION OF OFFICERS

AT the biennial election of officers and directors of the Army Ordnance Association held September 2, 1940, the following were reëlected to office for terms beginning January 1, 1941: president (to serve two years), Brig. Gen. Benedict Crowell, Cleveland, Ohio; vice-presidents (to serve two years), Col. William W. Coleman, Milwaukee, Wis., and Col. Frederick H. Payne, Greenfield, Mass.; directors (to serve four years), Col. Frank A. Scott, Cleveland, Ohio; Col. Robert P. Lamont, New York, N. Y., and Col. James L. Walsh, New York, N. Y.

The tellers of election who canvassed the ballots were: Lieut. Col. C. E. McRae, treasurer, Washington Post, chairman; Lieut. Col. R. O. Eliason, secretary, Washington Post, and Maj. Ralph Cook Scott, secretary, Los Angeles Post.

The nominating committee, of which announcement was made in the July-August issue, was: Philip H. Gadsden, Philadelphia, chairman; Lieut. Col. C. S. Robinson, Boston; Frank J. Smith, Rochester; J. B. Doan, Cincinnati, and Col. E. B. Meissner, St. Louis.

### MSTR. SGT. CLYDE WHITLATCH

ARMY ORDNANCE takes pride in felicitating Mstr. Sgt. Clyde Whitlatch, formerly of the 40th Ordnance Company, the Ordnance School, Aberdeen Proving Ground, Md., who retired from active military service August 31, 1940. He was the senior enlisted instructor of the school, and his guiding hand had done much in molding the enlisted instructors needed in the school's expansion.

Sergeant Whitlatch served for more than fifteen years in the Second Corps Area headquarters at Governors Island, New York, where he gained a wealth of knowledge and experience which he imparted to commissioned and noncommissioned officers alike. He originally enlisted in the Army on January 25, 1908. He first served in the Coast Artillery Corps and later in the Infantry. He entered the Ordnance Department in June 1916, since which time he has had uninterrupted service as a noncommissioned officer. On the day of his retirement, a general order published by the Ordnance School contained the following tribute: "Master Sergeant Whitlatch possesses those qualifications of loyalty to superiors, attention to duty, honesty, and sobriety which make him an example worthy of emulation by the younger men in the service. The retirement of such a splendid soldier cannot but cause regret that the Army must lose his services; however it has been well earned. The Ordnance Department extends to him its best wishes—in which his superiors and associates at the Ordnance School join most heartily—that his retired life may be long and happy and that he may feel with pride the gratitude and appreciation of the nation he has served so well."

### NEW MEMBERS

DURING the period August 1, 1940, to September 31, 1940, inclusive, the following applicants were admitted to membership in the Army Ordnance Association: O. A. Aaldnd, Torrance, Calif.; A. W. Abrahamsen, Inglewood, Calif.; C. E. Achuff, Newtonville, Mass.; Harold E. Adams, South Norwalk, Conn.; C. F. Ahlheim, Buffalo, N. Y.; S. H. Aiken, Akron, Ohio; James A. Allan, Washington, D. C.; B. S. Allen, New York, N. Y.; Samuel G. Allen, New York, N. Y.; Theodore G. Alteneder, Philadelphia, Pa.; Robert S. Alter, Cincinnati, Ohio; Henry I. Altshuler, Bolivia, S. A.; A. G. Anderson, Glen Ridge, N. J.; C. E. Anderson, East Orange, N. J.; E. B. Anderson, Packanack Lake, N. J.; J. G. Anderson, Saginaw, Mich.; Nelson Anderson, East Orange, N. J.; Walter M. Annette, New York, N. Y.; Thomas N. Armstrong, Jr., Summit, N. J.; Fred Arnold, Los Angeles, Calif.; Joseph Askin, Buffalo, N. Y.; T. J. Atcheson, Buffalo, N. Y.

Paul Babij, Detroit, Mich.; Benjamin B. Bachman, Ardmore, Pa.; Aaron B. Bagsar, Lansdowne, Pa.; Foldy Baker, Cleveland, Ohio; Harry A. Baker, Hudson, Mass.; Bernt Balchen, New York, N. Y.; Delbert Ball, San Francisco, Calif.; H. F. Ball, New York, N. Y.; John H. Ballantine, New York, N. Y.; John Ballantyne, Philadelphia, Pa.; Carl W. Banks, Trenton, N. J.; H. D. Barber, Cleveland, Ohio; A. T. Barnum, Philadelphia, Pa.; Robert Edward Barrett, Holyoke, Mass.; W. W. Barton, Rockford, Ill.; Carl O. Bathgate, Atlanta, Ga.; Orie L. Beardsley, Washington, D. C.; Wm. J. Beatty, Philadelphia, Pa.; Allen F. Beck, Columbus, Ohio; Myrwood A. Beck, Columbus, Ohio; Nathan S. Beck, Columbus, Ohio; Orie Bell, Columbus, Ohio; Louis B. Bender, Baltimore, Md.; Luther H. Bender, Washington, D. C.; Eugene C. Benington, Larchmont, N. Y.; Lee Benner, Lansing, Mich.; Archie W. Bennett, Syracuse, N. Y.; B. E. Bensinger, Chicago, Ill.; R. F. Bensinger, Chicago, Ill.; David L. Benstock, Brightwaters, N. Y.; Roy E. Berg, Long Island City, N. Y.; K. G. Berggren, West Orange, N. J.; Edward Besser, Louisville, Ky.; R. R. Bever, Detroit, Mich.; Paul H. Bilhuber, Long Island City, N. Y.; Ralph Billingham, Rockford, Ill.; A. H. Bishop, Baltimore, Md.; R. F. Black, Cleveland, Ohio; John C. Blackmore, Western Springs, Ill.; Joseph E. Bland, Louisville, Ky.; Samuel W. Blanton, Dayton, Ohio; M. T. Boden, Detroit, Mich.; M. E. Boehm, Houston, Tex.; Robert Boehnke, Columbus, Ohio; H. Bohland, St. Louis, Mo.; Luther M. Bolton, Washington, D. C.; V. C. Bonardel, Newark, N. J.; Frank A. Bond, Pittsburgh, Pa.; Oliver W. Bonnafe, Hudson, Mass.; C. G. Bonner, Chicago, Ill.; Lucius Messenger Boomer, New York, N. Y.; John M. Borland, Cleveland, Ohio; C. A. Borton, Ardmore, Pa.; George F. Bosch, Wabash, Ind.; George E. Bowdoin, New York, N. Y.; John Bowman, Philadelphia, Pa.; Harry E. Bradbury, South Norwalk, Conn.; Charles E. Briner, York, Pa.; Mason Britton, Washington, D. C.; Richard deWolfe Brixey, New York, N. Y.; B. N. Brockman, Chicago, Ill.; Robert B. Bromeley, Bradford, Pa.; Robert R. Brooks, Philadelphia, Pa.; J. J. Brown, Louisville, Ky.; Wylie Brown, New York, N. Y.; Frank M. Browning, Ogden, Utah; W. P. Buchanan, Boston, Mass.; James T. Buckley, Philadelphia, Pa.; T. B. Buell, Rockford, Ill.; Robert L. Bullock, Pedricktown, N. J.; C. M. Burgess, Geneva, Ill.; F. E. Burgess, Geneva, Ill.; J. L. Burgess, Chicago, Ill.; F. L. Burke, Anderson, Ind.; James E. Burke, Washington, D. C.; Richard S. Burke, Wayne, Ill.; Herbert S. Burling, South Orange, N. J.; Joseph S. Burton, Cleveland Heights, Ohio; S. L. Buschman, New York, N. Y.; Charles A. Butler, Utica, N. Y.

C. N. Cage, Detroit, Mich.; O. B. Cahoon, New York, N. Y.; James R. Callaway, Inglewood, Calif.; Arthur A. Cambria, Hudson, Mass.; Howard E. Campbell, Mariemont, Ohio; Ward M. Canaday, Toledo, Ohio; Harold S. Card, Elizabeth, N. J.; William Carey, Cleveland, Ohio; Harry Carlberg, Rockford, Ill.; C. B. Carlson, West Orange, N. J.; C. C. Carlton, Lansing, Mich.; William M. Chadbourne, New York, N. Y.; Paul Franklin Chenea, Berkeley, Calif.; S. F. Clabaugh, Washington, D. C.; J. Rex St. Clair, New York, N. Y.; A. J. Clark, West Orange, N. J.; George D. Clark, Jr., San Francisco, Calif.; H. J. Clark, Washington, D. C.; L. O. R. Clark, Hartford, Conn.; C. D. Cleaver, Anderson, Ind.; H. Paul Cleaver, Philadelphia, Pa.; D. L. Cleveland, Syracuse, N. Y.; H. M. Coale, Ardmore, Pa.; R. S. Cobb, West Lafayette, Ohio; J. C. Cobourn, Cleveland, Ohio; Herman Cohn, Philadelphia, Pa.; C. K. Cole, Jr., Long

Beach, Calif.; G. S. Cole, Jr., Syracuse, N. Y.; L. E. Conde, Rockford, Ill.; Louis Conrad, Baltimore, Md.; Walter L. Conwell, New York, N. Y.; James A. Cook, Chicago, Ill.; Belton Y. Cooper, Huntsville, Ala.; Daniel Cormack, New York, N. Y.; E. B. Corrigan, Utica, N. Y.; C. C. Cotton, Youngstown, Ohio; J. R. Cox, Cleveland, Ohio; C. T. Craig, Cleveland, Ohio; A. Russell Crawford, Bridgeton, N. J.; Jack Crawford, Minneapolis, Minn.; Henry Cucullu, St. Louis, Mo.; Alfred S. Curry, South Norwalk, Conn.; Herbert G. Curtis, Peoria, Ill.

J. C. Dabney, Dayton, Ohio; Austin F. Daley, Philadelphia, Pa.; J. R. Daley, Portland, Ore.; John P. Dalton, Aberdeen Proving Ground, Md.; Edwin J. Dannhardt, Rockville Center, L. I., N. Y.; C. W. Davie, New Britain, Conn.; H. F. Davis, Upper Darby, Pa.; Edwin T. Deal, Philadelphia, Pa.; J. H. Deasy, San Francisco, Calif.; James J. De Mario, Passaic, N. J.; Charles Demcko, Trenton, N. J.; George E. Deming, Philadelphia, Pa.; C. Paul Denckla, Haverford, Pa.; Henry W. Denny, New York, N. Y.; Ludolf Heres De Wyk, Sr., Ansonia, Conn.; Noah Dietrich, Houston, Tex.; George S. Dively, Cleveland, Ohio; John H. Dodge, Worcester, Mass.; M. Hartley Dodge, New York, N. Y.; W. Dollmeyer, Philadelphia, Pa.; William J. Donald, New York, N. Y.; Floyd F. Dore, Pittsburgh, Pa.; James C. Downs, Baltimore, Md.; J. A. Driy, St. Louis, Mo.; R. C. Du Brucq, Leetonia, Ohio; William S. Dun, Columbus, Ohio; O. L. Dyer, West Collingswood, N. J.

H. Earl, Anderson, Ind.; F. M. Edgar, Detroit, Mich.; H. F. Ehrich, Montebello, Calif.; William Ehrick, Columbus, Ohio; F. B. Eilers, Fort Wayne, Ind.; William H. Eister, West Haven, Conn.; Gust H. Ekstrom, Rockford, Ill.; E. A. Emerson, Middletown, Ohio; Karl Emerson, Bridgeton, N. J.; Wilton O. English, New Brunswick, N. J.; Louis Enz, Houston, Tex.; Nels Erickson, Minneapolis, Minn.; Walter Ernst, Mount Gilead, Ohio; A. B. Evans, Cleveland, Ohio; Reynold J. Evans, Newark, N. J.; Nick Even, Excelsior, Minn.; Otto Ewert, Rockford, Ill.

Davis Factor, Hollywood, Calif.; H. W. Falstrom, Bloomfield, N. J.; Frank Farrar, Newark, N. J.; J. W. Farrell, Salem, Ohio; B. A. Fay, Toledo, Ohio; Gordon T. Fedders, Buffalo, N. Y.; L. F. Fedders, Buffalo, N. Y.; K. L. Finkenstaedt, Rockford, Ill.; Philip J. Fiumara, Woodside, L. I., N. Y.; George H. Fleming, Pittsburgh, Pa.; Harry L. Fleming, Beloit, Wis.; H. W. Fletcher, Houston, Tex.; Alfred Flint, Marlboro, Mass.; H. A. Flogaus, Philadelphia, Pa.; W. V. Flood, Toledo, Ohio; Frank M. Folsom, Wilmette, Ill.; F. N. Foote, New York, N. Y.; Edward Foster, New York, N. Y.; D. R. Francis, Mount Gilead, Ohio; Samuel W. Fraser, Bronxville, N. Y.; John J. Frawley, Jr., Trenton, N. J.; R. T. Frisbie, New Britain, Conn.; Albert J. Fuge, Ozone Park, L. I., N. Y.; John J. B. Fulenwider, New Castle, Del.; E. L. Furguson, Cleveland, Ohio.

A. W. Gaebelein, New Britain, Conn.; John C. Gallagher, Ridgewood, N. J.; L. E. Garfield, Houston, Tex.; J. E. Garlent, Lansing, Mich.; D. H. Gearheart, Cleveland, Ohio; C. D. Geer, West Orange, N. J.; A. Gelpke, Ardmore, Pa.; R. P. Gibson, Detroit, Mich.; Joe H. Gill, Greenwich, Conn.; Joseph Givner, New York, N. Y.; Chas. H. Godschall, Philadelphia, Pa.; Mark Goedecke, Philadelphia, Pa.; H. R. Gohmann, Louisville, Ky.; Robert F. Golden, Newark, N. J.; James L. Goodwin, Hartford, Conn.; Charles R. Graham, Midland, Mich.; Arthur Grahame, Washington, D. C.; Bengt Granbert, Rockford, Ill.; Harry L. Grant, Washington, D. C.; M. B. Grant, Chicago, Ill.; J. F. Grassen, Wilmette, Ill.; Ralph I. Graves, Washington, D. C.; P. H. Gray, Montclair, N. J.; T. C. Gray, New York, N. Y.; Wm. H. Grimditch, Philadelphia, Pa.; James Grisinger, Columbus, Ohio; Oscar M. Grolla, San Francisco, Calif.; Frank D. Grossman, Philadelphia, Pa.; Robert N. Grove, Peru, Ind.; William E. Gruening, Cincinnati, Ohio; Larry E. Gubb, Philadelphia, Pa.; C. O. Guernsey, Philadelphia, Pa.; Elmo Guiles, San Francisco, Calif.; Frederick Gumm, Kearny, N. J.

O. W. Habel, Saginaw, Mich.; Lawrence R. Hafstad, Washington, D. C.; Andrew W. Hamilton, Washington, D. C.; Wade Hampton, Houston, Tex.; D. B. Hanna, Canton, Ohio; George C. Hannaway, St. Louis, Mo.; William M. Harbaugh, Jr., East Orange, N. J.; Ambrose H. Hardwick, Newark, N. J.; W. G. Hardy, McKees Rocks, Pa.; H. F. Harper, Lansing, Mich.; W. J. Harrington, St. Louis, Mo.; A. S. Harris, Cleveland Heights, Ohio; C. W. Harrold, University Heights, Ohio; Charles H. Hatch, Greenwich, Conn.; Russell C. Hatton, Los Angeles, Calif.; Harry Hawkins, Saginaw, Mich.; Joseph B. Hayes, Detroit, Mich.; Robert Hazel, Newark, N. J.; F. H. Hecht, Pittsburgh, Pa.; H. M. Heckathorn, Warren, Ohio; L. F. Heckman, Boston, Mass.; J. M. Heimerl, Buffalo, N. Y.; David Helm, York, Pa.; J. C. Helveston, Saginaw, Mich.; L. J. Henderson, Cleveland, Ohio; Anthony A. Henninger, Syracuse, N. Y.; A. W. Herrington, Indianapolis, Ind.; Leslie E. Hess, Drexel Hill, Pa.; O. P. Hick, New York, N. Y.; E. S. Higginbotham, New York, N. Y.; Harold C. Hill, Baltimore, Md.; Edward Hinman, Jr., New York, N. Y.; Horace Hoch, York, Pa.; A. Willard Hoffman, Cortland, N. Y.; E. L. Hoffman, Minneapolis, Minn.; J. J. Hoffman, Chicago, Ill.; C. S. Holden, Lansing, Mich.; K. L. Honeyman, Trenton, N. J.; Warren S. Hood, Vineland, N. J.; A. P. Hornor, West Orange, N. J.; J. E. Howard, Baltimore, Md.; Marshall E. Hoyt, South Norwalk, Conn.; Henry S. Hubbell, Boston, Mass.; L. S. Hubbert, New York, N. Y.; Aden F. Huber, Jr., Arlington, Va.; F. C. Hubley, Ardmore, Pa.; A. Hummel, New York, N. Y.; J. H. Hunt, Lansing, Mich.; E. W. Hussey, Portland, Ore.; E. E. Husted, Newark, N. J.; F. S. Hyde, Watertown, Conn.

D. B. Ingalls, Newark, N. J.; Robert N. Ingersoll, Longmeadow, Mass.; Harry L. Ingram, Jr., Walter Heights, McLean, Va.; M. H. Isenberg, New York, N. Y.; Paul S. Jackson, Rockford, Ill.; R. W. Jackson, Chicago, Ill.; Ansco E. Jann, Staten Island, N. Y.; Joseph F. Jewett, III, Wyoming, Ohio; C. B. Johnson, Geneva, Ill.; Charles F. H. Johnson, Passaic, N. J.; C. S. Johnson, Houston, Tex.; Frank L. Johnson, Chicago, Ill.; George Johnson, Rockford, Ill.; R. W. Johnson, Cincinnati, Ohio; Stanley Johnson, Lansing, Mich.; A. L. Johnston, Jr., Plainfield, N. J.; B. F. Jones, Cleveland, Ohio; Houston Jones, Sutherland, Nebr.; Owen C. Jones, Glenbrook, Conn.; Victor A. Jones, Andover, Mass.

C. R. Kaddeland, Cleveland, Ohio; Lewis P. Kalb, Muskegon, Mich.; Henry Kampf, Washington, D. C.; Albert Kaufman, Mount Vernon, N. Y.; Morgan R. Kavanagh, Pittsburgh, Pa.; R. V. Keck, Saginaw, Mich.; J. F. Keeler, Cleveland, Ohio; D. H. Kelly, Toledo, Ohio; William D. Kennedy, West Englewood, N. J.; Hjalmer Kent, Ann Arbor, Mich.; Seaver Clark Kenyon, Cleveland, Ohio; Francis K. Kernan, Utica, N. Y.; A. M. Kerr, Pittsburgh, Pa.; E. W. Kewitz, Cleveland, Ohio; George R. Killam, Jr., Ensley, Ala.; J. A. Kingston, Los Angeles, Calif.; R. G. Kiracofe, Fort Wayne, Ind.; R. J. Kirkby, Fort Wayne, Ind.; Henry M. Klein, Utica, N. Y.; Horace C. Knerr, Chestnut Hill, Philadelphia, Pa.; C. G. Knoblock, Sturgeon Bay, Wis.; J. L. Koubek, Detroit, Mich.; Gustav H. Koven, Jersey City, N. J.; Albert L. Kress, New York, N. Y.; Thomas A. Ashby-Poley-Hapsburg-Krock, New York, N. Y.; Gustave P. Krohn, Newark, N. J.; H. F. Kulas, Salem, Ohio; W. A. Kull, Saginaw, Mich.; C. P. Kumler, Dayton, Ohio; E. R. Kyler, Columbus, Ohio.

Charles William Lake, Jr., Ithaca, N. Y.; Archibald M. Langford, Hightstown, N. J.; Elmer T. Lang, Washington, D. C.; J. D. Lang, Baltimore, Md.; F. J. Lapointe, Ann Arbor, Mich.; F. J. Larkins, Philadelphia, Pa.; Lawrence A. Larson, Philadelphia, Pa.; Victor Larson, Geneva, Ill.; Elmer E. Latshaw, Philadelphia, Pa.; John D. Lawrence, New York, N. Y.; W. C. Lawson, Chicago, Ill.; F. D. Lehn, New York, N. Y.; Julius Lenkey, New Brunswick, N. J.; George A. Lewis, New York, N. Y.; G. A. Lindblade, Rockford, Ill.; Evar Lindgren, Geneva, Ill.; Franklin A. Lindsay, Washington, D. C.; Milton F. Lindsley, Jr., Cincinnati, Ohio; Frank H. Linthicum, Baltimore, Md.; Philip E. Littlehale, Milford, Conn.; Lloyd P. Lochridge, New York, N. Y.; Clarence M. Loder, Bridgeton, N. J.; Richard O. Loengard, New York, N. Y.; Calvin A. Lohmiller,

Cleveland, Ohio; Cyrus H. Loutrel, Jr., Newark, N. J.; C. W. Lucas, Bridgeton, N. J.; Joseph F. Lucas, Newark, N. J.; P. B. Lum, Washington, D. C.; Thomas F. Lundy, Jr., Brooklyn, N. Y.; Denham C. Lunt, Greenfield, Mass.

M. A. Macbeath, Akron, Ohio; J. F. MacEnulty, New York, N. Y.; W. C. MacFarlane, Minneapolis, Minn.; W. C. MacFarlane, Jr.; Moline, Ill.; W. H. MacFarland, Minneapolis, Minn.; John K. MacGowan, New York, N. Y.; Charles Macheras, Los Angeles, Calif.; A. MacLeod, Salem, Ohio; Howard F. MacMillin, Mount Gilead, Ohio; Kenneth Macomber, Hudson, Mass.; F. T. Macrae, Jr., Cleveland, Ohio; Charles R. Madary, Baltimore, Md.; George P. Mahoney, Marlboro, Mass.; William T. Manahan, Fort Benning, Ga.; C. E. Martin, Louisville, Ky.; R. G. Martin, Toledo, Ohio; John T. Mascuch, Morristown, N. J.; John Allan Mathews, Arlington, Va.; J. O. Matteson, Chicago, Ill.; C. E. Matthews, Trenton, N. J.; Crosby Maynard, Washington, D. C.; Oswald H. McClay, Ridgewood, N. J.; Harry McCool, Jr., Canton, Ohio; J. H. McDuffee, Toledo, Ohio; James McGee, Louisville, Ky.; Howard R. McHenry, Bridgeton, N. J.; James C. McKay, York, Pa.; Thomas J. McKay, Pittsburgh, Pa.; Thomas J. McKay, Jr., York, Pa.; George V. McLaughlin, Brooklyn, N. Y.; J. W. McLaughlin, New York, N. Y.; Thomas F. McManus, Newark, N. J.; J. Berry McOwen, Buffalo, N. Y.; Edward A. Mead, South Norwalk, Conn.; H. C. Mead, Anderson, Ind.; Philip Medicus, New York, N. Y.; Alfred W. Mellowes, Milwaukee, Wis.; Francis Mendrey, Trenton, N. J.; J. N. Merkle, Baltimore, Md.; C. J. Meyer, Louisville, Ky.; P. W. Meyeringh, Wilmington, Del.; P. M. Meyers, Bridgeton, N. J.; Luther C. Meyers, Bridgeton, N. J.; Raymond F. Meyers, Philadelphia, Pa.; C. A. Michel, Anderson, Ind.; L. H. Middleton, Toledo, Ohio; N. O. Millar, San Francisco, Calif.; Richard W. Millar, Pasadena, Calif.; H. Miller, St. Louis, Mo.; Jack T. Miller, Trenton, N. J.; Robert S. Miller, Malden, Mass.; William H. Miller, Utica, N. Y.; William J. Miller, Cincinnati, Ohio; J. A. Minch, Port Huron, Mich; C. O. Miniger, Toledo, Ohio; Frank Minkel, Buffalo, N. Y.; R. V. Mitchell, Canton, Ohio; Wilber Mitchell, Louisville, Ky.; Tom Mobley, Houston, Tex.; Edward D. Mohlere, Aberdeen Proving Ground, Md.; Nils V. Montan, Montclair, N. J.; D. H. Montgomery, New Britain, Conn.; James D. Mooney, New York, N. Y.; Charles W. Moore, Atlanta, Ga.; B. Morris, Kearny, N. J.; A. J. Moses, Chattanooga, Tenn.; Walter B. Moore, W. Lafayette, Ohio; Bryan Moorehead, Pittsburgh, Pa.; K. Henry Morck, Buffalo, N. Y.; John Davis Morgan, Jr., South Orange, N. J.; Elliott C. Morse, Detroit, Mich.; L. Gustam Moses, New York, N. Y.; F. E. Mullaly, Detroit, Mich; Joseph W. Mullen, New York, N. Y.; T. J. Mullen, Jr., Chicago, Ill.; Philip G. Mumford, New York, N. Y.; J. C. Murray, Jr., Yardley, Pa.; David N. Myers, Cleveland, Ohio; H. B. Myers, Cleveland, Ohio.

Franklin R. Nail, Allentown, Pa.; Harold S. Nash, South Norwalk, Conn.; Harold E. Nelson, Houston, Tex.; Ralph Neuhaus, Houston, Tex.; C. M. Niezer, Fort Wayne, Ind.; Thomas J. Nolan, Flushing, N. Y.; Charles E. Norton, Chicago, Ill.; N. Kenneth Norton, Washington, D. C.; Stanley M. Norwood, New York, N. Y.; James E. Nyhan, Dayton, Ohio.

C. C. Oberly, Fort Wayne, Ind.; F. L. O'Conner, Boston, Mass.; Malcolm J. Odell, Mendham, N. J.; Ed. L. Oerter, Philadelphia, Pa.; Hugo L. Olson, Rockford, Ill.; C. A. Orr, Canton, Ohio; Cyrus R. Osborn, Detroit, Mich.; B. R. Otto, Caldwell, N. J.; R. E. Otto, St. Louis, Mo.

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William F. Rader, Honolulu, T. H.; Sayre M. Ramsdell, Philadelphia, Pa.; J. F. Randall, New York, N. Y.; Henry M. Reed, Ben Avon, Pittsburgh, Pa.; R. W. Reno, Los Angeles, Calif.; W. B. Retz, New Britain, Conn.; Embree E. Reynolds, Arlington, Va.; James H. Reynolds, Jr., Washington, D. C.; John N. Reynolds, Trenton, N. J.; Robert D. Reynolds, Newark, N. J.; W. J. Reynolds, Lynbrook, N. Y.; Arthur B. Ricketts, Long Island City, N. Y.; James Riddell, Youngstown, Ohio; Robert B. Rigg, Chicago, Ill.; Homer W. Ring, South Norwalk, Conn.; John J. Ritchie, Jr., Cincinnati, Ohio; Frank J. Rittman, Trenton, N. J.; Ray B. Roberts, Washington, D. C.; E. A. Robertson, Newark, N. J.; James Hamilton Robins, Merion, Pa.; George H. Roderick, Grand Rapids, Mich.; William B. Rodgers, West Lafayette, Ohio; Ralph B. Rogers, New Rochelle, N. Y.; W. B. Romaine, Verona, N. J.; F. A. Ronzheimer, Geneva, Ill.; E. G. Rose, Washington, D. C.; Paul Rosefield, Brooklyn, N. Y.; E. W. Ross, Moline, Ill.; N. M. Ross, Syracuse, N. Y.; Sol Ross, Chicago, Ill.; Nathan M. Rothman, Brooklyn, N. Y.; Linus E. Russell, Springfield, Ohio; Robert P. Russell, Milburn, N. J.; C. H. Rystrom, Rockford, Ill.

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R. G. Vander Boom, Los Angeles, Calif.; Robert Glenn Van Ness, St. Paul, Minn.; Willard G. Van Saun, Janesville, Wis.; James E. Van Schoick, Nutley, N. J.; Charles H. Vaughn, Hudson, Mass.; Ben Van Zee, Minneapolis, Minn.; Carlo Vicario, New York, N. Y.

William B. Wachtler, New York, N. Y.; A. S. Wade, Detroit, Mich.; C. I. Wagner, East Orange, N. J.; Stanley Wagner, Louisville, Ky.; N. A. Walbran, Utica, N. Y.; R. E. Waldo, Anderson, Ind.; D. S. Walker, New York, N. Y.; E. R. Walker, Buffalo, N. Y.; Gus Waller, Geneva, Ill.; A. Walsh, West Orange, N. J.; W. J. Walters, New Brunswick, N. J.; Geo. H. Wanschura, St. Paul, Minn.; Horace Ward, Washington, D. C.; George W. Warwick, Mt. Lebanon, Pittsburgh, Pa.; E. Washburn, Baltimore, Md.; Henry S. Washburn, Plainville, Conn.; Earl Watson, Boston, Mass.; Joseph A. Watson, Lansing, Mich.; Paul E. Waugh, Fort Wayne, Ind.; A. J. Weatherhead, Jr., Cleveland, Ohio; John D. Webber, Bridgeton, N. J.; R. H. Weber, Belleville, N. J.; Gilbert E. Webster, Newark, N. J.; W. A. Wegner, Saginaw, Mich.; E. J. Weinberg, Saginaw, Mich.; A. C. Weigel, New York, N. Y.; Frank Weishan, Cleveland, Ohio; James M. Welch, Pittsburgh, Pa.; Rex W. Wells, Toledo, Ohio; W. G. Wells, Cleveland Heights, Ohio; Ferd E. Wertheim, New Brunswick, N. J.; E. G. Wertheimer, Milwaukee, Wis.; Samuel Beck West, East Cleveland, Ohio; Peter J. Westervelt, Cambridge, Mass.; Paul Westlake, York, Pa.; William M. Westwood, Wheeling, W. Va.; Roderick J. Whelan, Berea, Ohio; G. R. Whippo, Cleveland, Ohio; R. F. White, Salem, Ohio; Frederick S. Whiteside, Boston, Mass.; George E. Whitlock, Salem, Ohio; Russell W. Whitney, Hoboken, N. J.; Carl P. Wiedow, Burbank, Calif.; R. E. Wilcox, Cleveland, Ohio; J. P. Wilhelm, West Lafayette, Ohio; O. T. Wilkinson, Los Angeles, Calif.; Daniel Willard, Baltimore, Md.; C. S. Williams, West Orange, N. J.; Fred D. Williams, Philadelphia, Pa.; G. B. Williams, Cleveland, Ohio; Harold S. Williams, New York, N. Y.; Clarence M. Wilson, Chappaqua, N. Y.; George O. Wilson, Jr., Washington, D. C.; George S. Wilson, San Francisco, Calif.; William V. Wilson, Milford, Conn.; Ralph O. Wirtenburg, Bristol, Conn.; S. B. Withington, Muskegon, Mich.; Herman L. Wittstein, New Haven, Conn.; A. H. Wobbe, New York, N. Y.; C. F. Wohlhuter, Geneva, Ill.; George W. Wolf, New York, N. Y.; Joseph A. Wollow, Danielson, Conn.; Henry A. Wolsdorf, Rockaway, N. J.; Pierpont J. E. Wood, Beloit, Wis.; William H. Wood, Bloomfield, N. J.; John D. Works, Boston, Mass.; J. Worley, St. Louis, Mo.; George B. Wright, South Norwalk, Conn.; George W. Wright, Fort Wayne, Ind.; M. G. Wright, Denver, Colo.; H. F. Wykoff, Salem, Ohio.

Alfred J. Yardley, Darien, Conn.; Louis D. Yecies, Newark, N. J.; Karl M. Yost, Beloit, Wis.; Orville Young, II, Flint, Mich.; Wilber M. Young, Detroit, Mich.; D. C. Youngblood, Chicago, Ill.; Wilhelm Zeh, Newark, N. J.; C. J. Ziegfeld, New York, N. Y.; G. H. Zouck, Baltimore, Md.

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### Necrology

TYLER W. CARLISLE, a leader in the industrial development of Cleveland and a charter member of the Army Ordnance Association, died August 14, 1940. He was assistant chief of the Cleveland Ordnance District and had taken a leading part in Ordnance affairs since the World War.

Major Carlisle was born in Cleveland September 23, 1885, and was graduated from the Massachusetts Institute of Technology. In 1913 he entered the firm founded by his father—Strong, Carlisle & Hammond, manufacturers of machine tools, mill supplies, and distributors of electrical equipment. In 1916, as a member of the 107th Cavalry, he served on the Mexican border. The following year at Washington he assisted Col. Frank A. Scott in the early formation of the General Munitions Board and the War Industries Board. He attained the rank of major in the Ordnance Department in which he served until June 1919.

Major Carlisle was identified with many civic and humanitarian organizations in his native city. His service to the national defense was of the highest order both as an officer of the Army in time of war and as a citizen devoted to industrial preparedness in time of peace. His loss in both fields of endeavor is very great.

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CAPT. OTHO V. KEAN, U. S. Army, Retired, chief inspector and senior engineer of the Philadelphia Ordnance District, died August 30, 1940. A graduate of Virginia Military Institute and the United States Military Academy, class of 1905, Captain Kean, at the age of 59, had endeared himself to all his associates by his character, loyalty and ability. He had served in the War Department at Washington in recent years, and on June 1, 1939, he became a member of the staff of the Philadelphia Ordnance District. He had retired from the Army with the rank of captain in 1913, having served from 1909 to 1912 as associate professor of ordnance and gunnery at West Point. Subsequently he was engaged in private business in Providence, R. I.

His assistance in the current rearmament program was of unusual value. He combined a vast commercial experience with a deep military knowledge and tradition. ARMY ORDNANCE proffers its condolences to his many friends in the Ordnance organization upon the passing of this revered officer and fellow worker.

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HECTOR C. BYWATER, distinguished writer on naval affairs and frequent contributor to this journal, died at his home in Surrey, England, August 17, 1940. Since 1931 he had been naval correspondent of the *London Daily Telegraph*. By many he was considered the successor of the late Admiral Mahan, U.S.N., as an authority on naval theory and practice. He held the view that Great Britain could only welcome development of the United States as a strong Pacific power. He was a believer in the theory that battleships could hold the seas against aërial attack. He also was well known as the author of many books including "The Great Pacific War" (1925).

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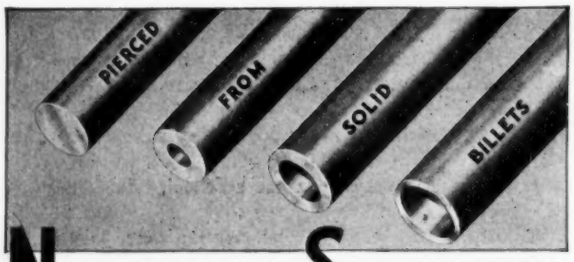
NOTICE has been received of the death of the following members of the Association: W. P. Chrysler, New York, N. Y.; Abram C. Denman, Los Angeles, Calif.; William M. Holm, Oakland, Calif.; Stephen Kelly, Fort Adams, R. I.; William E. Marble, Greenwich, Conn.; Harry T. McDonald, Peoria, Ill., and W. K. Strickland, Philadelphia, Pa.

# Ordnance Gazette

*The following is a roster of officers of the Ordnance Department of the Army, with their stations. Customary changes at this season of the year make it difficult to keep currently informed about friends and acquaintances in the Regular service and those Ordnance Reserve officers who have been ordered to extended active duty with the Ordnance Department. The latter are listed after the Regular officers. This gazette, corrected to Oct. 1, 1940, is published for the information of members of the Army Ordnance Association.*

## OFFICERS OF THE ORDNANCE DEPARTMENT, UNITED STATES ARMY

Adamson, Keith F., Lieut. Col., Ordnance Office, Washington, D. C.
Allen, Charles K., 1st Lieut., Fort Devens, Mass.
Aman, Joseph L., Maj., Hq. Eighth Corps Area, Fort Sam Houston, Tex.
Anderson, Roland B., 2nd Lieut., Ordnance School, Aberdeen Proving Ground, Md.
Armitage, John D., 1st Lieut., Aberdeen Proving Ground, Md.
Armstrong, Donald, Col., Chicago Ordnance District, 309 W. Jackson Boulevard, Chicago, Ill.
Atwood, Frank J., Lieut. Col., Ordnance Office, Washington, D. C.
Aurand, Henry S., Lieut. Col., (G. S. C.), Office of the Chief of Staff, Washington, D. C.
Baird, Arthur R., Maj., Los Angeles Ordnance Region, San Francisco Ordnance District, 409 Chamber of Commerce Building, Los Angeles, Calif.
Baker, James O., 1st Lieut., Aberdeen Proving Ground, Md.
Baker, Robert G., 1st Lieut., Ordnance School, Aberdeen Proving Ground, Md.
Bandholtz, Cleveland H., Lieut. Col., Raritan Arsenal, Metuchen, N. J.
Barclay, John A., Jr., 1st Lieut., Corozal, C. Z.
Bardsley, George H., Maj., U. S. Military Mission, American Embassy, Rio de Janeiro, Brazil.
Barnes, George R., Capt., MacDill Field, Tampa, Fla.
Barnes, Gladeon M., Brig. Gen., Ordnance Office, Washington, D. C.
Barr, Robert S., Lieut. Col., Honolulu, T. H.
Barroll, Morris K., Jr., Lieut. Col., Ordnance Office, Washington, D. C.
Barry, Edwin F., Maj., Manila, P. I.
Bassett, Ralph H., Maj., Hamilton Field, Calif.
Beatty, John C., Lieut. Col. (Ret.), Watervliet Arsenal, Watervliet, N. Y. (active duty with rank of major).
Becker, Ward E., Maj., Ordnance Office, Washington, D. C.
Bell, William L., Jr., Capt., U. S. Military Academy, West Point, N. Y.
Bellinger, John B., Maj., 4th Division, Fort Benning, Ga.
Bernd, Peter P., 1st Lieut., Ordnance School, Aberdeen Proving Ground, Md.
Beyma, Severin R., 1st Lieut., Ordnance Office, Washington, D. C.
Billingsley, John D., Capt., Ordnance School (Staff and Faculty), Aberdeen Proving Ground, Md.
Blackmore, Philip G., Lieut. Col., Hq. Seventh Corps Area, Omaha, Nebr.
Blodgett, Robert S., 1st Lieut., Langley Field, Va.
Boatwright, Walter P., Col., Frankford Arsenal, Philadelphia, Pa.
Bodeau, Edward, 1st Lieut., Mitchel Field, Hempstead, Long Island, N. Y.
Bodine, Robert N., Lieut. Col., Ordnance Office, Washington, D. C.
Bomar, Ernest C., Lieut. Col., Frankford Arsenal, Philadelphia, Pa.
Booth, Lucian D., Col., Ordnance Office, Washington, D. C.
Booton, John G., Col., San Antonio Arsenal, San Antonio, Tex.
Borden, William A., Lieut. Col., Ordnance Office, Washington, D. C.
Bothwell, Frederick C., Jr., 1st Lieut., Ordnance School, Aberdeen Proving Ground, Md.
Bower, Harvey, 1st Lieut., Ordnance School, Aberdeen Proving Ground, Md.
Bowlin, Roy L., Lieut. Col., Rochester Ordnance District, 1132 Mercantile Building, Rochester, N. Y.
Breakefield, Durward E., 1st Lieut., Watertown Arsenal, Watertown, Mass.
Breen, John J., Maj., Springfield Armory, Springfield, Mass.
Bricker, L. Monroe, Lieut. Col., Hq. Fifth Corps Area, Fort Hayes, Columbus, Ohio.
Brierley, James S., 1st Lieut., Ordnance School, Aberdeen Proving Ground, Md.
Broberg, Waldemar S., Maj., Philadelphia Ordnance District, 1417 Mitten, Philadelphia, Pa.
Brooks, John A., Jr., Lieut. Col., Springfield Armory, Springfield, Mass.
Brown, John E., Maj., Delaware Ordnance Depot, Pedricktown, N. J.
Brown, Percy H., Jr., Capt., Ordnance School, Aberdeen Proving Ground, Md.
Buck, Champlin F., Jr., 1st Lieut., Watertown Arsenal, Watertown, Mass.
Burns, James H., Maj. Gen., Office of the Assistant Secretary of War, Washington, D. C.
Butler, Robert G., Jr., Capt., U. S. Military Academy, West Point, N. Y.
Buyers, Archie S., Lieut. Col., Picatinny Arsenal, Dover, N. J.
Cabell, De Rosey C., Lieut. Col., Aberdeen Proving Ground, Md.
Cain, James A., Jr., 1st Lieut., Maxwell Field, Ala.
Call, William A., 1st Lieut., Ordnance School (Staff and Faculty), Aberdeen Proving Ground, Md.
Campbell, Harry L., Lieut. Col., Hq. First Corps Area, Army Base, Boston 9, Mass.
Campbell, Levin H., Jr., Brig. Gen., Ordnance Office, Washington, D. C.
Capron, Webster A., Col., Honolulu, T. H.
Carlson, Gunnar C., 1st Lieut., Ordnance School, Aberdeen Proving Ground, Md.
Case, Rolland W., Col., Watertown Arsenal, Watertown, Mass.
Cave, John W., 1st Lieut., Aberdeen Proving Ground, Md.
Chatfield, Miles B., 1st Lieut., Frankford Arsenal, Philadelphia, Pa.
Chavin, Raphael S., Lieut. Col., Picatinny Arsenal, Dover, N. J.
Childs, Jefferson D., 1st Lieut., Raritan Arsenal, Metuchen, N. J.
Christmas, John K., Lieut. Col., Aberdeen Proving Ground, Md.
Churchill, Harold W., Lieut. Col., Ordnance Office, Washington, D. C.
Clark, Thomas A., Col., Rock Island Arsenal, Rock Island, Ill.
Clement, John K., Col., New York Ordnance District, 80 Broadway, New York, N. Y.
Coffey, John W., Maj., Ordnance Office, Washington, D. C.
Colby, Joseph M., Capt., Aberdeen Proving Ground, Md.
Collins, Everett, Col., Hq. Fifth Corps Area, Fort Hayes, Columbus, Ohio
Cone, John M., 1st Lieut., Corozal, C. Z.
Connelly, Stanley W., 1st Lieut., Ordnance School, Aberdeen Proving Ground, Md.
Conner, Steven L., Maj., Watervliet Arsenal, Watervliet, N. Y.
Conway, Harold J., Maj., Ordnance School (Staff and Faculty), Aberdeen Proving Ground, Md.
Coombs, Raymond H., Capt., Rock Island Arsenal, Rock Island, Ill.

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Cowhey, Joseph L., 1st Lieut., Ordnance School, Aberdeen Proving Ground, Md.
Cozart, Clarence A., 1st Lieut., Raritan Arsenal, Metuchen, N. J.
Crabb, Frederick G., Jr., Capt., Ordnance School, Aberdeen Proving Ground, Md.
Crain, James K., Brig. Gen., Ordnance Office, Washington, D. C.
Crane, Richard Z., Maj., Detroit Ordnance District, 1832 National Bank Building, Detroit, Mich.
Crawford, David J., Maj., Ordnance Office, Washington, D. C.
Crawford, James S., Maj., Boston Ordnance District, 140 Federal St., Boston, Mass.
Crim, Lemuel P., Maj., Savanna Ordnance Depot, Proving Ground, Ill.
Crowe, William J., Maj., Ordnance Office, Washington, D. C.
Crump, Ira A., Lieut. Col., Ordnance Office, Washington, D. C.
Cummings, Emerson L., Capt., Ordnance Office, Washington, D. C.
Custis, Arthur B., Maj., Honolulu, T. H.
Cyr, Arthur R., 1st Lieut., McChord Field, Wash.
Daniel, Samuel A., 1st Lieut., Ordnance School (Staff and Faculty), Aberdeen Proving Ground, Md.
Daniels, Robert W., Lieut. Col., Fort Bliss, Tex.
Darby, Marshall E., Maj., National Guard Bureau, Washington, D. C.
Davis, Merle H., Maj., Ordnance Office, Washington, D. C.
Davis, William A., 1st Lieut., Langley Field, Va.
Davisson, Horace G., 1st Lieut., Ordnance School, Aberdeen Proving Ground, Md.
DeGuire, Merlin L., 1st Lieut., Ordnance School, Aberdeen Proving Ground, Md.
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Deylitz, Paul L., Maj., Rock Island Arsenal, Rock Island, Ill.
Dickson, John R. V., 1st Lieut., Ordnance School, Aberdeen Proving Ground, Md.
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Ford, Elbert L., Lieut. Col., Springfield Armory, Springfield, Mass.
Foy, John F., 1st Lieut., Honolulu, T. H.
Frank, Selby H., Lieut. Col., San Juan, P. R.
Franklin, Edward C., Capt., Ordnance Office, Washington, D. C.
Freeman, James W., Maj., Ordnance Office, Washington, D. C.
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Goebert, Elmer C., Lieut. Col., Rock Island Arsenal, Rock Island, Ill.
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Hansen, Floyd A., 1st Lieut., Picatinny Arsenal, Dover, N. J.
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Haskell, Robert K., Maj., Watertown Arsenal, Watertown, Mass.
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Heintz, Leo H., 1st Lieut., San Juan, P. R.
Heiss, Gerson K., Maj., Office of the Assistant Secretary of War, Washington, D. C.
Henry, William J., Maj., Watertown Arsenal, Watertown, Mass.
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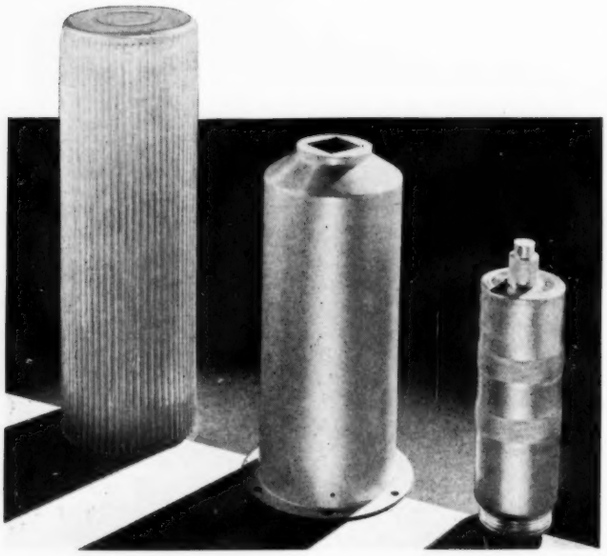

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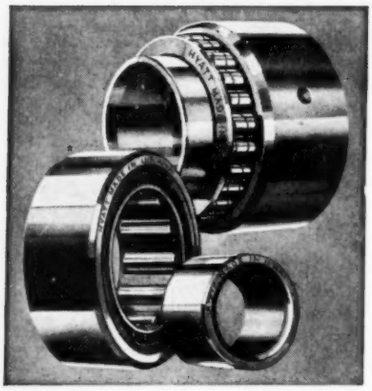

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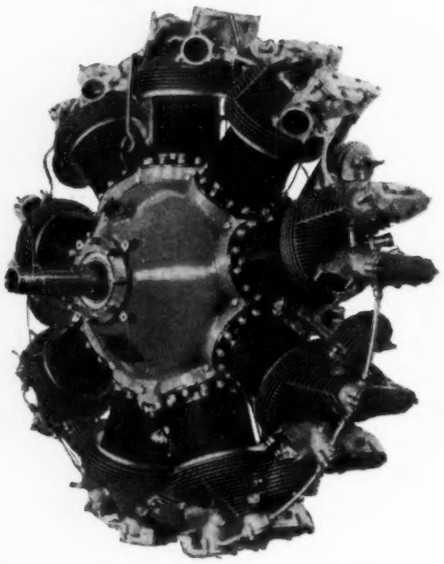

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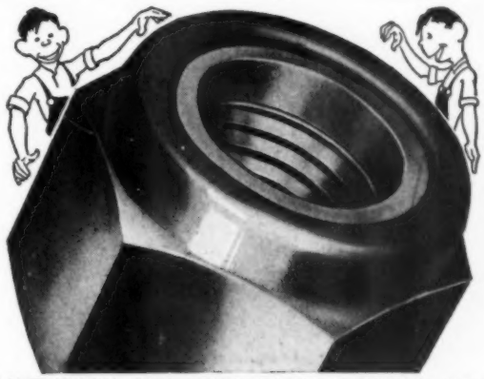

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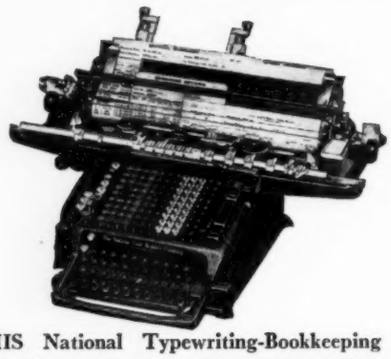

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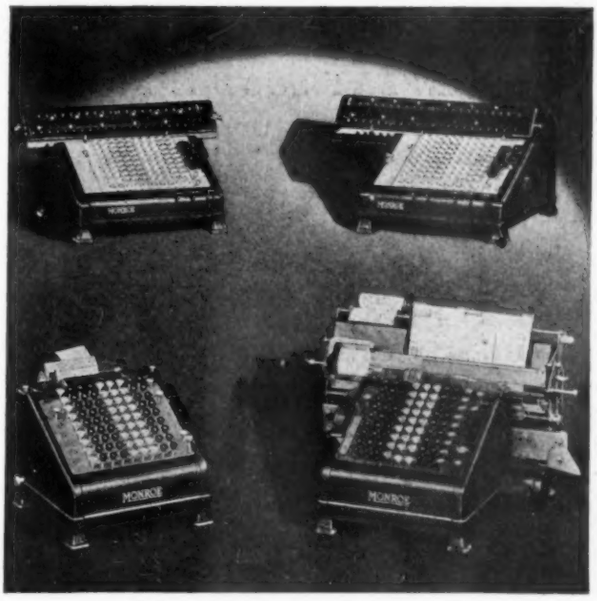


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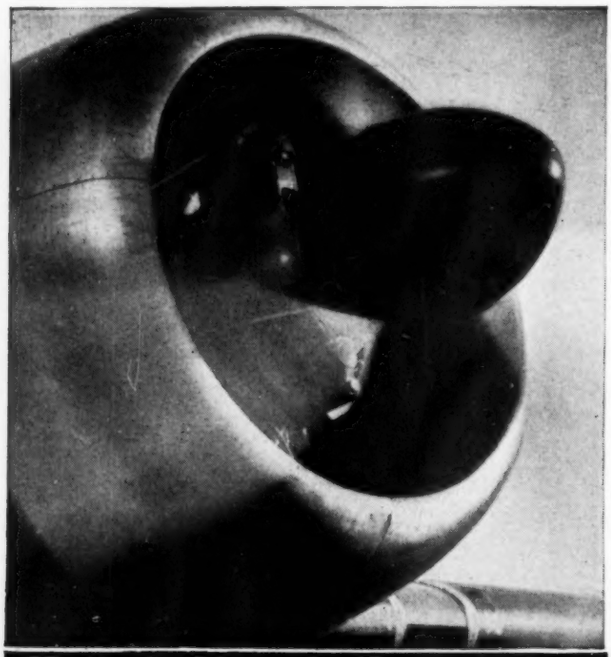

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# Ordnance Reserve

## POLICY REGARDING RESIGNATIONS AND ACTIVE DUTY FOR RESERVE OFFICERS

THE War Department announced on September 10, 1940, that, in conformity with the provisions of S. J. Res. 286, as passed by the Seventy-sixth Congress, any member of the Reserve components of the Army of the United States below the grade of captain who has any person or persons dependent solely upon him for support and who has no means of support other than his wages, salary, or other compensation for personal services, may offer to resign his commission, or, in the case of enlisted reserves, may ask to be discharged from his enlistment, upon individual requests made prior to or within twenty days after the date of entry into active military service. If they do not submit their resignations, they will be inducted for one year's active duty. In all other instances, members of the Officers' Reserve Corps who offer their resignations during the present emergency will have them accepted only in such instances as the Secretary of War may specially authorize.

The War Department points out that a Reserve officer is under no compulsion at the time he takes his oath of office. He freely agrees to serve his country in time of need, and it is with such understanding that the Government spends money on his military training. There is no agreement on the part of the Government to release him at any time during the five years of his current appointment. When resignations are accepted they are at the convenience of the Government.

The War Department, however, in administering the act which authorizes ordering members of the Officers' Reserve Corps to extended active duty without their consent during the current limited emergency, intends to reduce the inconvenience and sacrifice of Reserve officers to the very minimum. Instructions are being issued to corps-area commanders and other assignment authorities to attach great weight to the requests of Reserve officers who desire deferment of their active duty, and to consider the personal financial obligations of Reserve officers in determining the order in which they should be called to extended active duty. All members of the active Officers' Reserve Corps are currently being circularized in order that such personnel information may be available to assignment authorities for consideration in establishing the sequence in which Reserve officers will be selected for active duty. The War Department regrets that in some cases personal financial sacrifices may result from ordering members of the Officers' Reserve Corps to extended active duty without their consent, but it would be impossible for the War Department to execute its military training program for the fiscal year 1941 without their assistance.

There are now approximately 120,000 members of the Officers' Reserve Corps. Of this number approximately 13,000 are now on duty with the Regular Army. The Regular Army officer strength is not to be increased during the emergency, but Reserve officers as needed are to be ordered to duty to aid in training the expanded Army. The Reserve officers now on duty with the Regular Army volunteered their services and are mainly first and second lieutenants under 35 years of age, and some captains under 40 years of age. As the Army is increased, Reserve officers gradually will be ordered in to meet needs. If current plans progress unchanged, there will be approximately 45,000 Reserve officers on duty with the Army of the United States by the spring of 1941. The Officers' Reserve Corps receives approximately 9,000 Reserve officers a year from the senior divisions of the R.O.T.C., from 300 to 500 from men who have completed four years of the C.M.T.C., and a variable number from schools for Air Corps Reserve officers.

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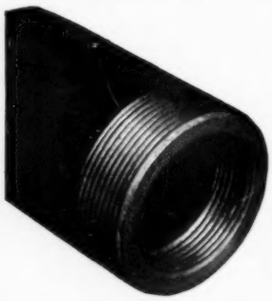

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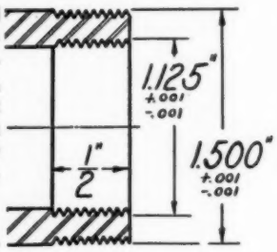


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THE War Department announced on September 11, 1940, details for the conduct by examining boards of medical examinations for Reserve officers who are ordered to extended active duty and National Guard officers who are ordered to active duty for periods in excess of thirty days.

The War Department announcement said that physical standards for appointment, reappointment, promotion, and all active duty are now prescribed in Army Regulations 40-105, Army Regulations 40-100, and, in addition for Air Corps officers, in Army Regulations 40-110. "These standards will be strictly adhered to," the announcement stated. It added that X-rays of the chest and serological tests will be made only where specially indicated when examining candidates for initial appointment, reappointment, or promotion in the National Guard of the United States, or in the Officers' Reserve Corps.

Reserve officers who apply for an initial tour of active duty in excess of thirty days (as distinguished from applications for continuance on such duty) will receive a preliminary physical examination not more than ninety days prior to entrance on such active duty. This examination will be as thorough as possible in order to avoid expense and inconvenience to the Government and to the individual. If the applicant lives near an Army hospital or dispensary providing X-ray, electrocardiographic, and laboratory facilities, he should report there for the preliminary physical examination which in that case will be of the scope of the final examination referred to in the following subparagraph. The examination of the final type is preferable; failing that, an examination by a Regular Army Medical officer is desirable, and if that is not practicable, the corps-area commander will designate a Medical Reserve officer to conduct it. If the preliminary examination does not disclose disqualifying defects, the officer will be ordered to active duty.

Immediately upon reporting for active duty, a final physical examination will be made by a board of two or more medical officers at least one of whom, and more when available, shall be an officer of the Medical Corps of the Regular Army. But if the officer has been found physically qualified upon examination of the final type made by a board of two or more medical officers, at least one of whom shall have been an officer of the Medical Corps of the Regular Army, within the preceding thirty days, the examination made upon reporting for active duty will be limited to that necessary to exclude defects arising from intercurrent illness or injury since the above examination. This final examination will be made at an Army general hospital, station hospital, or general dispensary where professional specialists and proper facilities are available for complete physical examination including X-ray, electrocardiogram, and laboratory. This examination will include X-ray of the chest, electrocardiogram, where indicated, and laboratory tests.

If the preliminary examination does not definitely disclose physical disqualifications but indicates a doubt of final qualification upon a more searching examination, the Reserve officer, if he desires to be considered for active duty in excess of thirty days, will be required to report at his own expense to an Army hospital for a physical examination identical in scope with, and conducted by a board of officers such as provided for, the final examination for Reserve officers found physically qualified in the preliminary examination. If found physically qualified in the final examination he will be ordered to active duty; if found physically disqualified his case will be disposed of as prescribed.

An electrocardiographic examination will be required as part of the final-type examination of Reserve officers when ordered to extended active duty for periods in excess of thirty days: (1) For officers 50 years of age or older; (2) for officers 45 years of age or older where such officers are required by assignment or orders to participate regularly in airplane flights; (3) for all other officers where, in the opinion of the medical examiner, such examination is indicated.

An electrocardiographic examination will be required as part

of the final-type examination of officers of the National Guard of the United States when ordered into Federal service: (1) For officers 50 years of age or older; (2) for officers 45 years of age or older where such officers are required by assignment or orders to participate regularly in airplane flights; (3) for all other officers where, in the opinion of the medical examiner, such examination is indicated.

In addition to the report of the cardiologist, a copy of the electrocardiographic tracing will be attached to the report of the physical examination. All cases of marked underweight will be investigated carefully for an accurate determination of physical fitness. Examination made at other than Regular Army posts, general hospitals, or general dispensaries, will be made without expense to the Government.

The physical examination of Reserve officers ordered to active duty for periods less than thirty-one days and the certification upon relief from such duty will be made as set forth in paragraphs 57 and 58, AR 140-5, as corps-area and department commanders are authorized: (1) To make final determination on the qualification of individual officers without reference to the War Department, except in cases involving physical fitness for flying. Action in the latter cases will be as prescribed in AR 40-110. (2) To grant waivers for physical defects. In this connection, prior waivers will not be considered binding. Corps-area and department commanders will forward to The Adjutant General a copy of the report of physical examination with a notation of the action taken thereon, for file with each officer's record.

A RESERVE officer found physically disqualified for reappointment, promotion, or active duty, will, if he makes request in writing, either be placed in the Inactive Reserve or, if in the opinion of corps-area or department commander, the defect is correctible within a period of one year, be continued in the active section under a waiver of the physical defect subject to reëxamination. The officer must report for reëxamination at his own expense within one year after the waiver is granted, otherwise he will be transferred to the Inactive Reserve upon request, or be discharged. If the officer fails upon reëxamination to meet the physical standards, he may request transfer to the Inactive Reserve; otherwise his service will be terminated. A Reserve officer awaiting reëxamination will not be eligible for active duty. If a Reserve officer found physically disqualified fails to request transfer to the Inactive Reserve or to request a waiver subject to reëxamination, his service will be terminated.

A Reserve officer found physically disqualified in a final examination will be accorded the rights provided by the act of June 15, 1936, if pertinent. Otherwise he will be promptly relieved from active duty, ordered to his home and his case disposed of. If the preliminary physical examination consisted of an examination of the final-examination type and was held not more than thirty days prior to entrance on active duty, the examination made after reporting on active duty will be limited to that necessary to determine the general health of the Reserve officer.

If the preliminary examination discloses disqualifying defects, the officer will be so informed and advised that he will be accorded the privilege of a reëxamination under the same conditions, and his case will be handled in the same manner as set forth for doubtful cases. In the event he declines the privilege of reporting for such reëxamination, the report of the preliminary examination will be forwarded to The Adjutant General for appropriate action, with the statement that the officer declined the privilege of reëxamination.

During a period of extended active duty in excess of thirty days, including all authorized extensions which are continuous and without a break, only such physical examinations will be made as are required for officers of the Regular Army for health reasons. (This will not apply to Reserve officers who are now on extended active duty under orders issued prior to April 3, 1939,

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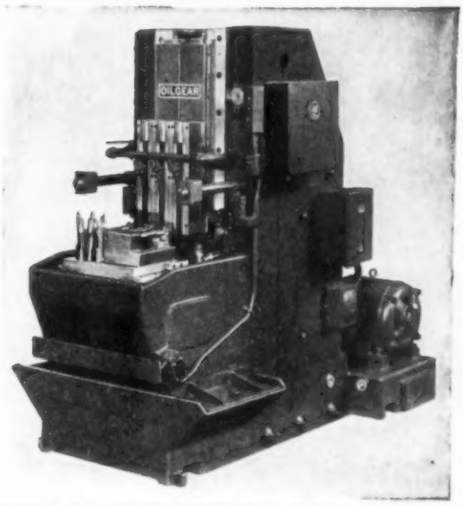


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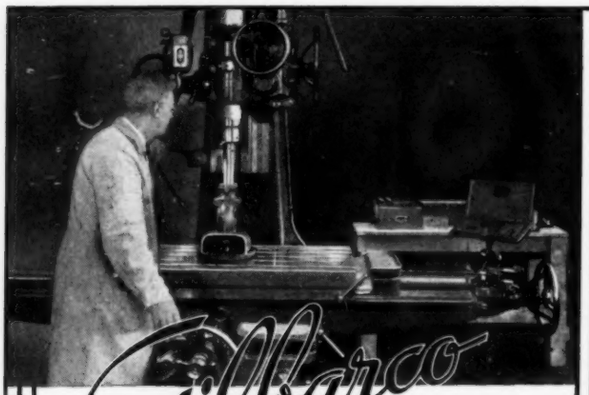

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until such officers are given a physical examination of the type prescribed for the final physical examination. That examination will be given prior to entering upon the first extension of the period of extended active duty.)

Reserve officers to be relieved from extended active duty of over thirty days, as distinguished from Reserve officers on such extended active duty whose tours are extended without interruption for an additional period or periods in excess of thirty days, will be given terminal physical examinations conducted by a board and of the scope provided for the final examination immediately prior to departing for their homes, if terminal leave has not been granted, except that serological tests for syphilis will not be required. If terminal leave is granted, the terminal physical examination will be given immediately prior to departing on such leave, and the officer will be advised in writing that in the event he believes himself to have incurred physical disqualifications in line of duty during the period of terminal leave of absence, he should report at his own expense to the nearest facility for conducting a terminal physical examination of the type heretofore described for a reëxamination; that otherwise the terminal physical examination given prior to departure on terminal leave will be final and conclusive as to his physical condition upon completion of the period of extended active duty. (A Reserve officer on foreign service will be given the terminal examination in the continental United States in the vicinity of the port or at the station where his tour of active duty terminates.)

When the terminal physical examination discloses that a Reserve officer has a disability that may entitle him to the retirement pay benefits of Section V of the act of April 3, 1939, or if such disability becomes evident while he is on active duty, or if such action is requested by a Reserve officer on active duty in excess of thirty days for a disability incurred subsequent to April 3, 1939, he will be ordered to a general hospital for observation and treatment, line of duty being determined as provided by paragraph *2e* (*3*), AR 35-3420. At the termination of the treatment in the general hospital, the proceedings of a Disposition Board will be forwarded to the War Department with the recommendation of the commanding officer of the hospital. In any case in which the War Department determines that the Reserve officer has incurred a disability in line of duty which materially interferes with his ability to perform satisfactorily in peace or war the duties of his office as prescribed by law or regulations or the customs of the service, he will be ordered before a duly constituted Army Retiring Board.

Revised standards for appointment in the Officers' Reserve Corps will not be applied to those R.O.T.C. students who are now in advanced courses. Standards applicable at the time these students entered the advanced course will be applied in their initial appointment in the Officers' Reserve Corps.

H. E. A.

INDEX TO ARMY ORDNANCE VOLUME XX

WITH TITLE PAGE FOR BINDING IS NOW READY

**The Index is arranged alphabetically by subject and author. It includes all data published in the magazine from the July-August 1939 issue (No. 115) to and including the May-June 1940 issue (No. 120).**

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# Ordnance in Review

## THREE NEWCOMERS TO THE SPORTSMAN'S LIBRARY

BY LIEUT. COL. CALVIN GODDARD

THREE books of such interest to the sporting-arms fraternity have recently come from the press that this author feels it only fitting to devote his current offering entirely to consideration and comment regarding them. First there is "The Hunting Rifle," by Col. Townsend Whelen; secondly, "Mastering the Pistol," by Morris Fisher, and thirdly, "The Muzzle-Loading Cap-Lock Rifle," by Ned H. Roberts—titles and authors which should indeed whet the insatiable knowledge-appetite of all true gun lovers. And so to work. . . .

Townsend Whelen, dean of American riflemen, has written a book. This hardly constitutes an adventure for the beloved Colonel, as the writing of books is no novelty to him. But it is good news to that great company of riflemen to whom his word is law—his voice the voice of a prophet. The libraries of all True Believers long have embraced one or more of his many works, perhaps the best known of which are "The American Rifle" (1917) and "Wilderness Hunting and Wildcraft" (1926). And now we have his "Hunting Rifle" (Harrisburg: Stackpole Sons; 463 pp.; $4.75) to bring the literature on this type of arm completely up to date.

This volume is divided into two major parts: the first (12 chapters—286 pp.) devoted to matériel, and the second (14 chapters—165 pp.) to marksmanship. The latter is followed by a 6-page appendix and an index. The illustrations, of which there are 88, include both photographs and drawings. These are alike apt and interesting, our chief criticisms here being that Fig. 3 (p. 16) is inverted—the powder grains in the sectionalized cartridges shown therein defying the law of gravity—Fig. 60 (p. 327) rotated from the perpendicular, and Fig. 52 (p. 308) is so poor in contrasts that the beginner can gain from it but little information of value. In this connection, it strikes this reviewer that the sum total of the illustrations on the employment of the sling (of which Fig. 52 is one) falls far short of that required for adequate illumination upon this vitally important procedure. Crossman has been much more informative in his depiction of the same subject in "Military and Sporting Rifle Shooting" (p. 46) and "Small-Bore Rifle Shooting" (pp. 200-202), and the Colonel might well give thought to improving, in a future edition, his portrayal of the technique involved.

This book being on *sporting* rifles, Whelen sticks to his last and confines himself to currently produced weapons of that class and to central-fire calibers alone. He further disregards all products which he feels cannot be designated "first-class," foreign-made arms, and at least two *sporting* models of excellent parentage and unquestioned popularity with the hunstman of 1940—the Winchester caliber .351 "self-loader" and the Remington Model 81 "autoloader" (the old Model 8 revamped), both terms being synonymous with "semiautomatic." The latter weapon is chambered for cartridges of three calibers (.30, .32, and .35) and formerly handled still another (.25). The characteristics of all these are discussed but with scarcely so much as a verbal glance at the rifle for which they were designed. The author also leaves severely alone the sporting models of the new Johnson semiautomatic rifle (now temporarily withdrawn from the market), a weapon which has its enthusiastic (and not inarticulate) proponents. Thus the only varieties of action which receive treatment are the bolt, the lever, and the slide (trombone), while the sole production-scale models discussed are those emanating from Winchester, Remington, and Savage. And although the directory of makers, dealers, etc., in the appendix

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carried the names of Griffin & Howe, and Niedner, as among those doing custom rifle work, no reference to the Sedgley Company of Philadelphia, probably the most active in this field, is to be found.

Of cartridges described and discussed by the Colonel, we find a total of twenty. These commence with the .22 "Hornet" and end with the .375 "Magnum," the list including such newcomers as the .218 "Bee" and .219 "Zipper," while old-timers are represented by the .25-20 and .25-35 W.C.F., the .30-30 and .303 (Savage) and the perennially youthful 7-mm. His exposition, in this chapter, of the reasons for the adoption by the War Department for use in the Garand rifle, of the M2, caliber .30, bullet in place of the M1 (pp. 204-205) is logical and convincing and merits perusal by anyone seeking enlightenment on this controversial subject.

Whelen has a great deal to say on the matter of rear peep sights and telescopes, and very little to remark on the usual V rear and bead front sighting equipment of the average sporting rifle, lacking as he does words adequate to convey his opinion of such. And since he has made a profound study of the telescope and of sights of all types, his offerings on these subjects are not only interesting but highly pertinent and authoritative. The same holds for his discussion of binoculars, spotting telescopes, and other shooting accessories, to which fourteen pages are devoted.

In the chapter on "Stocks," the tyro learns a great many things about this particular component of the rifle, and probably will be amazed to hear that unless its dimensions be such as to fit him individually, he is likely to experience many heartaches once he takes the field. But later, in "Custom Built Rifles and Cartridges," he becomes somewhat cheered by the assurance that the best arms companies are now turning out standard models of sporting rifles so satisfactory in every respect that there remains little reason for the man of average stature—and pocketbook—to go to the effort and expense of acquiring other than a production-line weapon from such a source. That which the reviewer found more interesting, however, than any other material in the volume was the chapter on "Trajectory." Here Whelen introduces a new and handy method of ascertaining, from figures on standard types of ammunition supplied by the factories, not the height of the trajectory curve at any given point over a specified range—which is academically interesting but none too helpful practically—but the trajectory height *above the line of aim,* a horse of quite another color and one capable of being put to very real use. Fig. 80 (p. 400) and the attendant descriptive matter tell the story in detail. Look them up!

MORRIS FISHER is evidently one of those rare souls who possess the capacity for being jacks-at-all-trades—and *good* at every one of them. Yet good is hardly the word, for this redoubtable Leatherneck, not content with winning an Olympic rifle championship, started from scratch so far as pistol shooting was concerned and calmly proceeded to become rifle *and pistol* champion of the Marine Corps! Now cometh before the bar of American pistoleers, his little volume, "Mastering the Pistol" (New York: G. P. Putnam's Sons; $2.25). Whether it will be able to carve for itself a niche in the sportsman's Hall of Fame appears questionable to this reviewer in view of the number and comprehensiveness of the works on the same subject which have preceded it.

But pistol shooting, like any other art or science, is a subject upon which the last word has never yet been said—nor ever will be—and Fisher has managed to discover a number of new and interesting (to this reviewer) things to say about it. He accents, as he should, the fact that dexterity with the hand gun is acquired in one way only—by hard work constantly applied, and that he who would achieve a top rating in the field must be prepared to practice, *practice,* PRACTICE, and then practice some more—the least relaxation of this self-imposed regimen resulting in a prompt falling off in his scores. That he speaks truly, no devotee of the pistol will deny, and if his little volume

does no more than discourage some of the half-hearted, it will have been worth while.

Practically our only criticisms apply to the section on "Range Terms" (pp. 125-133) wherein Fisher forgets that he is writing about pistols and revolvers, and inserts a number of definitions pertinent only in a book on rifle shooting. He likewise slips badly when he states (p. 129) that the salt left in the bore of an arm after firing is "potassium *chlorate*." As a matter of fact it is the *chloride* of potassium, a salt with very different properties, and this only when the original (undetonated) primer compound contains the chlorate—a component long banished from most primer mixtures employed in sporting ammunition. Other of his definitions are subject to like criticism, and the entire glossary of "Range Terms" should be carefully overhauled. The book as a whole, however, is to be commended.

THE name of Roberts is not unknown to modern sporting and target enthusiasts, for the caliber .257 cartridge which bears it, though still a comparative newcomer in these fields, has more than won its spurs in each. That Ned Roberts never before has undertaken to record his vast experience in book form, so much of it bearing upon muzzle-loading weapons, we may attribute to a modesty as rare as it is sincere. And for the fact that he has at long last favored us with a work at once timely, authoritative, and comprehensive (though in the last instance not so much so as he would have liked it to be), we may render thanks both to Mr. Roberts and the kindly Providence which has preserved him—mayhap for this very purpose. The book is, of course, "The Muzzle-Loading Cap-Lock Rifle" (Manchester, N. H.: Granite State Press; 432 pp.; $4.50).

Timely? Yes. The National Muzzle-Loading Rifle Association, born some years past, is now a lusty youngster, counting its members as the leaves of the trees, and holding annual, and other, competitions overshadowed only by the National Matches at Camp Perry. So generally has it stimulated interest in the weapon of its choice that at least one of our ammunition companies has taken cognizance of the new trend. As a result, the percussion-cap, instead of joining in outlawry scores of fine old black-powder cartridges which have of recent years been placed upon the "discontinued" list, now blossoms forth, if you please, with *noncorrosive priming!*

To make even a modest attempt adequately to outline and comment upon the subject matter of the present offering is impossible here. Suffice it to say that the work comprises some twelve chapters, the first devoted to the general construction of the rifle, the last to a partial list of old-time rifle makers. But between the covers lies such a wealth of information as this reviewer never dreamed existed in the brain of any man now living. Illustrations, too, there are aplenty—115 of them, all interesting, and many as revealing as the choice morsels of descriptive matter scattered with delightful frequency throughout the pages of the work. The only possible criticism which might be pertinent concerns the location of certain cuts and drawings, these too often being at a very considerable distance from the text in which reference to them is made. Indeed, in certain instances, it proved impossible to run them to earth at all. However, Roberts has done a great job, a job which needed doing, and which few, if any, could have done as well. May his years be long in the land!

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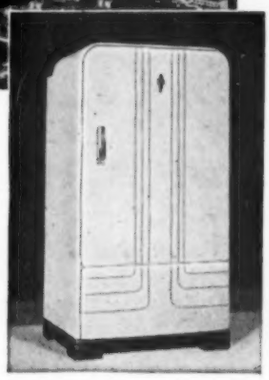

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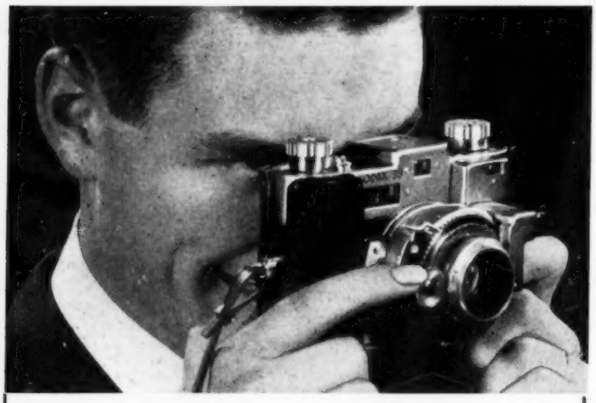

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## Professional Digest

*The following items of current information and opinion aim to present a wide range of facts and discussion relating to recent developments of professional military interest. Quotation marks are frequently omitted but sources are indicated.*

THE ATTAINMENT OF ADDITIONAL PRODUCTION and production capacity for critical items of ordnance has resulted in the placement of the following especially noteworthy orders for new plant and equipment. These orders have been placed by the Ordnance Department with the approval of the National Defense Advisory Commission. The date following the name of the contractor is that of the official announcement of the award, the figure in dollars is the approximate cost. All contracts are on a fixed-fee basis; *i.e.*, cost plus a definite fee in contradistinction to the frequent World War practice—cost plus a fixed percentage of cost.

To Chrysler Corporation, Detroit, Mich. (August 15, 1940): Plant and equipment, $20,000,000; production $33,500,000. These amounts are for constructing and equipping a military tank plant and building tanks on a quantity-production basis. The plant is expected to be ready for production in about one year. Chrysler Corporation will procure the site, build and equip the plant, and transfer title to the Government, which will reimburse the corporation for all costs thereof. The corporation will lease the plant during the period of contract for one dollar a year, operate and maintain it, and build tanks at a fixed price per tank in accordance with Army designs. The plant will have a floor area of about 800,000 square feet and will be located in the Detroit area on a site of approximately 113 acres. Between 4,000 and 5,000 men are expected to be employed for the initial production desired by the Government. The plant will embody the most modern practice in tool and machinery design, in layout, and in plant and production engineering. It also will be readily adapted to expansion.

To Hercules Powder Company, Wilmington, Del. (August 16, 1940): Construction of a smokeless-powder plant near Radford, Va., $25,000,000. The plant will be owned by the Federal Government which has retained the Hercules Powder Company to construct and operate it on a fixed-fee basis. Some 2,500 acres of land near Radford are being purchased as the site for the plant. Construction, which will begin immediately, will require about ten months. The production capacity of the plant will be 200,000 pounds of powder a day.

To Atlas Powder Company, Wilmington, Del. (August 28, 1940): Construction of an ammunition loading plant near Ravenna, Ohio, $14,215,000. This plant also will be owned by the Federal Government which has retained the Atlas Powder Company to construct it on a fixed-fee basis. Some 17,000 acres of land near Ravenna, about 15 miles from Akron, Ohio, are being purchased as the site for the plant. Construction will begin immediately and will require about ten months.

To Savage Arms Corporation, Utica, N. Y. (September 7, 1940): Equipping a machine-gun plant, $17,600,000. The company will purchase or produce and then install in existing buildings now owned by that firm the equipment necessary for the quantity production of machine guns. Title to this equipment will remain with the Government. Upon completion of the tooling, which is to be accomplished within fifteen months, the Savage Arms Corporation will operate the facilities for the War Department under production orders to be announced at a later date.

To Stone & Webster Engineering Company, New York, N. Y. (September 20, 1940): Construction and operation of

a plant at Wilmington, Ill., to produce TNT and DNT, $10,863,000. After completion, the E. I. du Pont de Nemours & Company will operate the plant for the Government on a cost-plus-fixed-fee basis. A production award of approximately $6,700,000 has been given the Du Pont Company.

To Sanderson & Porter, New York, N. Y. (September 24, 1940): Construction and operation of an ammunition loading plant near Wilmington, Ill., $14,000,000. The plant will be owned by the Federal Government which has retained Sanderson & Porter to construct it on a cost-plus-fixed-fee basis. Construction, which will begin immediately, will require about twelve months. This plant is in addition to the TNT and DNT plant in the same locality.

To Henry Disston & Sons, Inc., Philadelphia, Pa. (October 4, 1940): Increased facilities for the manufacture of armor plate, $1,018,400. This contract involves an addition to the present Disston plant on land now owned by the Government, which will more than double the capacity of present facilities. The plant will be constructed by Barclay White & Company of Philadelphia. The architect and engineer will be the Irving S. Towsley Company of Philadelphia.

THE WAR DEPARTMENT ANNOUNCED ON SEPtember 29, 1940, the selection of Union Center, Ind., as a site for a loading plant for the Ordnance Department. Agents selected by the Quartermaster Corps have been ordered to Union Center to proceed with the purchase of approximately 13,000 acres of land for the United States Government. The plant will be constructed and operated by civilians on a cost-plus-a-fixed-fee basis. Negotiations for the construction of the plant and the production of the powder are now in progress. When completed the plant will provide employment for approximately 6,000 persons. The Department also announced on October 9, 1940, the selection of Gadsden, Ala., as a site for a shell-forging and machining plant for the Ordnance Department. Agents selected by the Quartermaster Corps have been ordered to proceed with the purchase of approximately 150 acres of land for the United States Government for this purpose. The plant will be owned by the Federal Government and operated by the Landsdowne Steel & Iron Company, of Morton, Pa.

POTENTIAL SUPPLIES OF TOLUENE USED IN THE highly important explosive, TNT, are adequate for all anticipated United States requirements, according to a report of the National Defense Advisory Commission. Our present position is in sharp contrast with the situation prevailing during the World War, the report stated, as at that time this country had only limited facilities for recovering coal-tar products and the difficulties of getting adequate amounts of toluene resulted in a serious bottleneck in our emergency production of war supplies. The regular commercial needs for toluene in certain types of paints, lacquers, and other materials can now easily be met by recovery from by-product coke ovens, and the petroleum industry will be able to produce more than enough for expected military purposes. Domestic demand which accounts for over two-thirds of production in this country is customarily relatively stable and no significant increases are currently in prospect. Foreign demand has shown some tendency to decline as important European markets have been shut off by the war.

The mononitro compounds of toluene, an aromatic hydrocarbon, furnish ortho- and para-toluidines, two valuable bases employed in the production of magenta and other aniline dyes.

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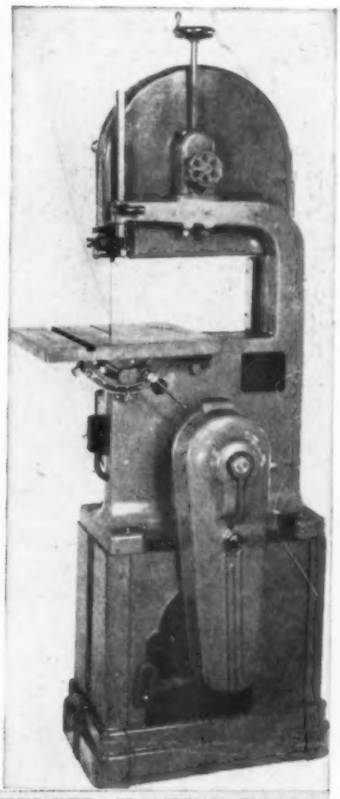

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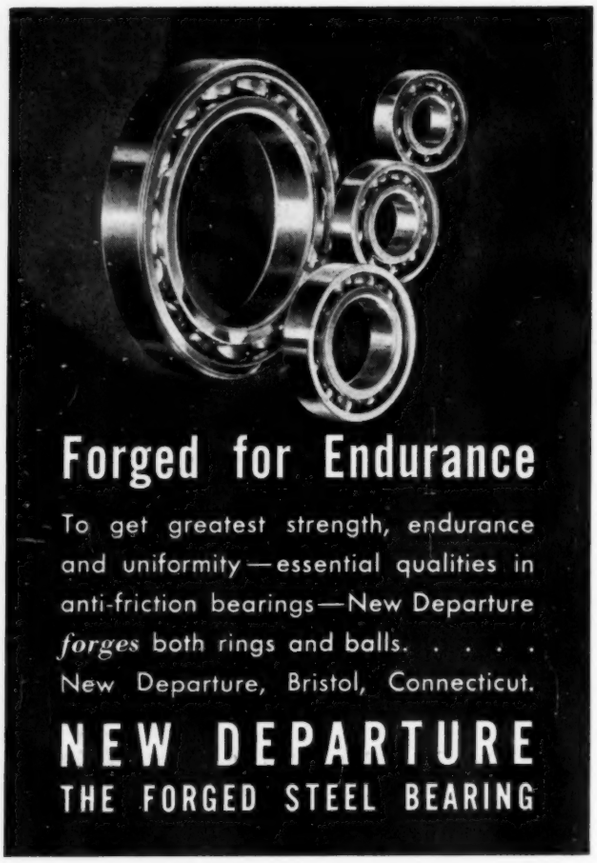
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# Book Reviews

MOBILIZING CIVILIAN AMERICA. By Harold J. Tobin and Percy W. Bidwell. New York: Council on Foreign Relations. 276 pp. $2.75.

DR. HAROLD J. TOBIN, professor of political science at Dartmouth College, and Dr. Percy W. Bidwell, director of studies for the Council on Foreign Relations, have produced a critical analysis of the Industrial Mobilization Plan, as last revised in 1939. As a matter of fact, "Mobilizing Civilian America" shows how civilian America *should be* mobilized and how it could have been mobilized—not how it is being mobilized at present. For instance, on May 16, 1940, the President of the United States addressed the Congress as follows: "I should like to see this nation geared up to the ability to turn out at least 50,000 planes a year. Furthermore, I believe that this nation should plan at this time a program that would provide us with 50,000 military and naval planes."

The time for academic planning has passed and the period of actual mobilization of industry has started. Viewed in this light, May 16, 1940, was, in effect, M-day from an industrial standpoint. And yet on August 9, 1940—nearly three months after emergency measures were initiated—Col. Henry L. Stimson, the recently appointed Secretary of War, was required by his innate honesty to testify before the House Ways and Means Committee and the Senate Finance Committee as follows: "In other words, Congress made available to the Army during the month of June approximately $400,000,000 for airplanes, engines, and accessories. Yet today, almost 7 weeks later, we have been able to sign contracts for the construction of but 33 planes of the 4,000 or more for which these appropriations were made."

The fault, he said, "as far as I am aware," is *not with the Army, nor with the Defense Commission, nor with the plane manufacturers.* Risks are inherent in any business enterprise. Industry may be expected to take normal risks. But the risk to industry of undertaking, at the request of the Government, to expand at its own expense its plant capacity and of then being left, upon a sudden cessation of the emergency, with these expanded facilities useless, is one that is entitled to special consideration. Under these circumstances, the uncertainty of future taxation affected by this expanded construction not only fails to give the special consideration above mentioned but penalizes the situation. It is this element of uncertainty in respect to the industry's right quickly to amortize its investments in expanded construction and also the uncertainty as to the amount and character of taxation which will be levied during the period of the contract, which have chiefly prevented the expectation of these contracts."

A few days later, according to the *New York Times* of August 12, 1940, a midwestern Senator gave notice at a hearing of the tax bill before the House Ways and Means and Senate Finance Committees of his opposition to the special allowances for amortization of the national-defense plants and plant expansions unless there was a division of contracts and plants to give his and other Midwestern States a greater part of the outlay for defense than they were receiving!

The book is well documented, which engenders confidence in its accuracy. However, one sentence implies that the congressional investigation (1919) of the so-called Graham Committee of expenditures in the Ordnance Department during the World War brought to light "much waste and extravagance, some stupidity and dishonesty. . ." This is not in accordance with the facts. On pages 48 and 49 of the hearings, House of Representatives, War Expenditures, Serial 1, 1919-21, is the following:

"The fact is that the committee has, through special employees, examined a large list of cases. The House authorized the committee to make expenditures without limit in the prosecution of its investigations and the committee has employed attorneys, expert accountants, and special investigators to aid it in its endeavors. The War Department has coöperated with the committee and with its representatives in every possible way. No effort to retard or hinder the committee in any respect has been made. The claims boards have consisted of men of highest personal integrity and they have had the aid of expert technical advisers, many of both these classes of officials remaining in the Government service at sacrifices to their own financial interests. The majority gives no credit for the vast constructive work which has been performed in the settlement and adjustment of these claims. No business task of a magnitude equal to this has ever at any time confronted the Government of the United States—nothing even approaching it in magnitude. The matter has been dealt with as a business matter, not as a political matter. It will be most unfortunate if politics be now thrust into what is a strictly business proposition. No credit is given in the majority report for the good. Only the few things which the majority chooses to assert may be criticized are given place in their report.

"Of contracts, both formal and informal, more than 22,500 have been adjusted. The uncompleted portion of these contracts and of claims settled or adjusted in cases where the contracts are not to be completed aggregate more than two billions of dollars. These have been adjusted and settled for about $330,000,000, which latter amount includes some $78,000,000 of partial settlements and awards. In other words, the War Department Claims Boards have been able to settle for about twelve per cent more than two billions of dollars of outstanding Government obligations.

"There is no evidence before the committee to indicate the slightest laxity upon the part of the Secretary of War in the matter of any adjustments made or the review of same. Upon the contrary, the evidence shows that the services of the Military Intelligence Branch of the War Department have been and are being utilized wherever it has been deemed necessary to scrutinize any claim or review any award on the ground of its unfairness to the Government.

"There is no evidence of a single case before the committee of there having been allowed prospective or possible profits contrary to the provisions of the Dent Act."

And on July 23, 1925, Jerome Michael, director of the War Transactions Section of the United States Department of Justice, wrote Maj. Gen. John A. Hull, Judge Advocate General, United States Army, as follows:

"Dear General Hull: As you know, the Joint Board of Survey has for some time been examining into Ordnance contracts and settlements, by means of examiners, under the immediate charge of Mr. Marcum. The Department of Justice has borne the cost of this work from the appropriation for the investigation and prosecution of war frauds.

"We have recently carefully considered the necessity and desirability of further participation by this Department in the Ordnance survey, and we have reached the conclusion, in which the Attorney General concurs, that it is neither necessary nor desirable that this Department further participate in that work. However, since it is an activity of the Joint Board of Survey, we do not feel that we should disturb it except with the approval of the War Department. We therefore desire to submit the entire matter to you. Our conclusion is based upon the following reasons:

"1. The experience of 2½ years has shown either that practically no frauds were perpetrated against the Government in the more than 3,600 Ordnance settlements which have heretofore been surveyed or that a survey of the character being conducted cannot be expected to reveal such frauds. From the standpoint, therefore, of the detection and prosecution, civilly and criminally,


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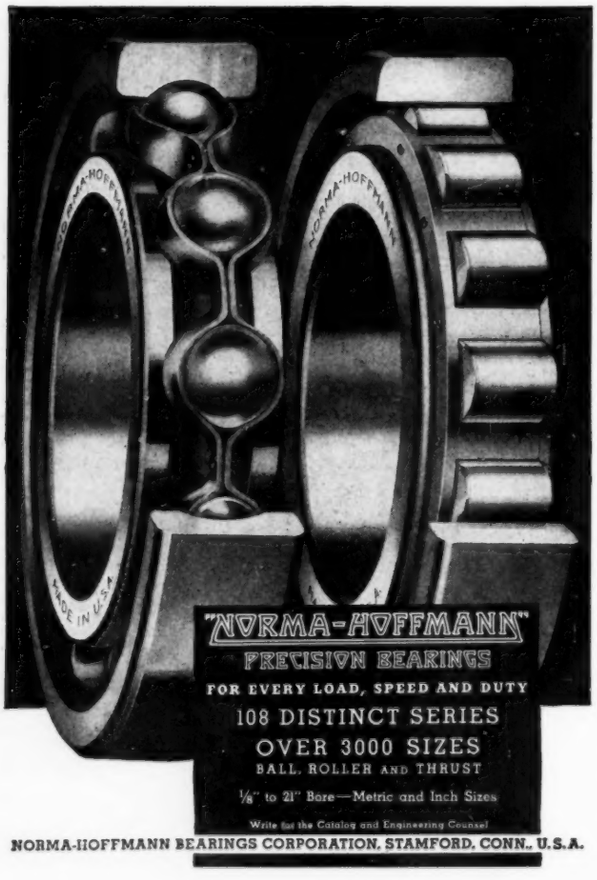
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of war frauds there does not seem to be any reason for continuing this work.

"2. Since it has been demonstrated that the work of the Ordnance survey cannot be expected to disclose frauds, the matter resolves itself into a search for civil claims, involving no fraud. There would seem to be no good reason at this time, whatever may be said of the past, why claims arising from war transactions which involve no fraud should be treated differently from claims growing out of the ordinary activities of the War or any other executive Department. This Department feels that if, as the result of the War Department's war and postwar transactions, claims have accrued in favor of the Government, the War Department and the General Accounting Office should and will, in the performance of their normal functions, discover and assert such claims and, if the assistance of this Department is required in that connection, will call upon it therefor.

"3. As I understand it, the survey conducted by the Joint Board of Survey originated in the belief that it was desirable, as quickly as possible, to make a survey of all war contracts. While it was understood that such a survey would necessarily have to be superficial, it was believed that it would be the means of revealing quickly the most glaring instances of fraud and other irregularities. Time was of the essence, and it was contemplated that the survey work would long since have been completed. From the beginning, this Department has devoted to the work as many men as its appropriations for that purpose would permit. There are approximately twenty-five thousand Ordnance settlements, of which less than four thousand have been surveyed in more than two years. It would take several years to complete this survey, depending upon the extent to which the number of examiners employed therein could be increased. In other words, it is no longer possible to achieve the original purpose of the survey. That being so, no reason appears why further examination into these settlements should not be made by those agencies which normally would have made it if the Joint Board of Survey had not been created.

"4. I understood that all cases in which fraud or irregularities were charged by the Graham Committee, or by other agencies, either public or private, and most of the larger war transactions, had been surveyed by the Joint Board. The transactions which have not been heretofore surveyed consist chiefly of the smaller transactions and of transactions in connection with which no charge of fraud or irregularity has been made. The Ordnance survey at the present time is confining its attention to approximately thirteen hundred settlements involving awards in excess of $100,000. If the Ordnance survey is to be continued, an effort should be made to complete the survey of those settlements during the present fiscal year. In order to do so at least fifteen additional examiners would have to be employed, so that the cost of the work to June 30, 1926, would be approximately $38,000. In our judgment the results of the work at this time do not justify that expenditure.

"If you feel that the matter is one which should be presented to a formal meeting of the Joint Board of Survey, we should be glad to have a meeting called for that purpose. If, on the other hand, you think the matter is one which may be handled informally by conferences between representatives of this Department and of the War Department, we should be glad to dispose of it that way. In any event, we should like to reach some final conclusion with regard to the matter as soon as possible, because if the Ordnance survey is to be discontinued, it is desirable to discontinue it quickly in the interest of economy. Very truly yours, For the Directors of the War Transactions Section, Jerome Michael, *Director.*"

This is an historic letter; Messrs. Tobin and Bidwell should not have overlooked it. Had they not done so they would not have permitted the impression that the ordnance errors of the World War were mistakes of the head and not of the heart. Whatever may be inferred from that effort, it was honest in word and in deed. J. L. W.

OLD BALD HEAD: THE PORTRAIT OF A SOLDIER. By Percy Gatling Hamlin. Strasburg, Va.: Shenandoah Publishing House.

WHEN, in January 1936, this reviewer passed upon Captain Hamlin's small volume, "The Making of a Soldier," he ventured the hope that the author might sometime give us a larger life of General Ewell, built upon a broader base than Ewell's personal letters. This Captain Hamlin now has done. He seems also to have borne in mind the criticism that all too small a part of his earlier work was devoted to the Civil War years, for no less than 150 of the present volume's 212 pages are given to that period. The volume is rich in that type of personal anecdote which so marks the Civil War and adds so much to the American reader's interest. The book is historically well done, though the faintest suspicion of "antimilitarism" very occasionally creeps into the work.

From Ewell's birth in Georgetown and his formative years in Virginia and at West Point, the author takes us quickly through young Ewell's tours of duty on the frontier and in Mexico. A short account of the gathering conflict of interests between North and South ushers in the great drama in which General Ewell was to play so large a part. The swift unfolding of a soldier's character under the terrific pressure of a major conflict is well shown. Ewell quickly imposed discipline on the uniformed mob which was called an army in the first months of the war. He showed great capacity as a subordinate officer, and though as an independent commander he displayed real faults, it should be remembered that he was suddenly thrown into competition with some of the greatest soldiers of the age.

The author's picture of Gettysburg is a most worth-while study of some phases of that great action. A vivid account of the evacuation of Richmond and of the surrender at Appomattox closes the war years, and with Ewell's retirement to his farm the life of a gallant soldier is brought to a close. F. W. F. G.

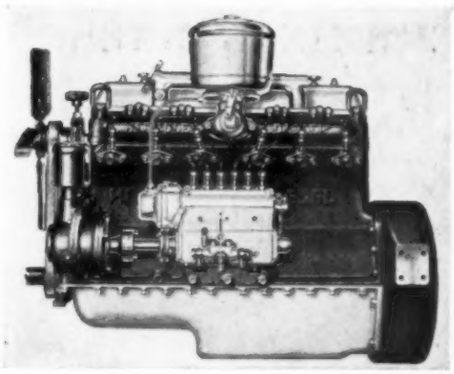
A DICTIONARY OF METALS AND THEIR ALLOYS. By F. J. Camm. New York: Chemical Publishing Co., Inc. $3.00.

THIS book can hardly be said to do justice to its ambitious title. In character it is more of a sketchy glossary than a dictionary, and in scope it is limited to about 800 headings, including repetitive cross-indexings. When it is realized that 800 is just about the number of American steels alone, and considering that the headings in this book refer largely to European proprietary alloys on which few useful comparative characteristics are given—and then only sketchy notes of general metals—the limited value of the book can be seen. Here, for example, is the author's description of tin plate: "Thin sheet iron which has been dipped into a bath of molten tin and thereby superficially coated with the latter metal." Or here, again, is the book's description of naval brass, one of the most important groups of alloys of the brass mills: "Naval brass. Composition: copper 59%, zinc 40%; tin 1%." Such hasty, incomplete, and erroneous descriptions, leave one with the impression that the author started out with an ambitious title and introduction but failed in his job.

G. S. B.

MILITARY HISTORY OF CARLISLE AND CARLISLE BARRACKS. By Lieut. Col. Thomas G. Tousey, M.C., U.S. Army. Richmond: The Dietz Press. $3.50.

THIS is the first exhaustive record of the military history of Carlisle from frontier outpost to the present Medical Field Service School. Here are combined in one narrative an interesting description of the men, the places, and the ideals which today are the military and medical institution at Carlisle. Colonel Tousey's text is marked by accuracy and thoroughness. May his energy and ability lead other biographers to prepare similar texts on other military-scientific institutions equally important in our national life. O. E. D.



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